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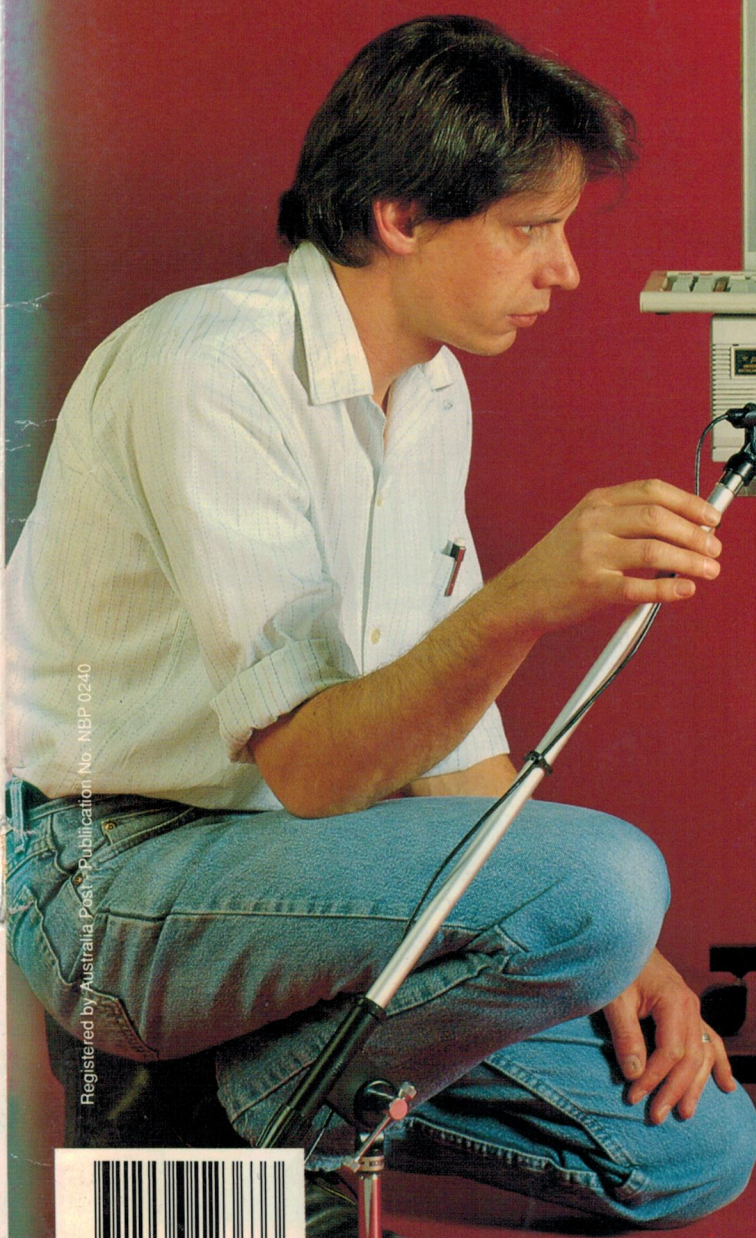
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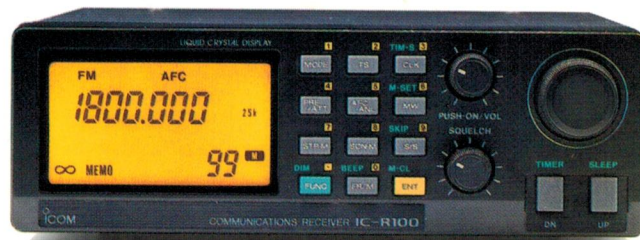
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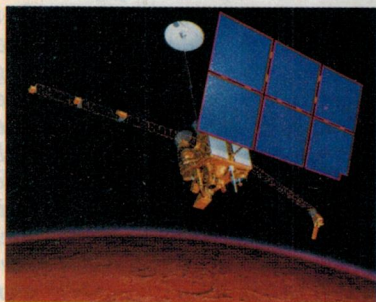


Volume 54, No.11

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AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Back for a closer look...



NASA's newly-launched Mars Observer should now be on its way, bristling with sensors and other instruments. By October 1993, it's planned to be gathering more information on our nearest neighbour in the solar system — taking up where the earlier Viking missions left off. Kate Doolan tells the story, starting on page 28.

For the serious user...



The new Sony V6000 Hi-8 camcorder is nominally a high-end consumer model, but its features and facilities tend to position it more at the economy end of the professional market. Barrie Smith has been trying one out, and his report starts on page 8.

On the cover

VAF Research sent us samples of their new low cost audiophile kit speaker systems (see page 34), and EA's technical editor Rob Evans checked them out using our PC-based LMS testing system. He's seen here setting up for one of the DC-7 enclosures. (Photo by Kevin Ling)

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MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO

FEATURES EDITOR
Peter Murtagh, B.Sc, Dip.Ed.

TECHNICAL EDITOR
Rob Evans, CET (RMIT)

TECHNICAL CONSULTANT
Peter Phillips, B.Ed., Dip Ed., ECC

CONTRIBUTORS
Neville Williams, FIREE, VK2XV

Jim Lawler, MTETIA

Arthur Cushen, MBE

Tom Moffat, VK7TM

Peter Lankshear

SECRETARY

Ana Maria Zamora

PRODUCTION EDITOR

Mille Godden

DRAFTING

Karen Rowlands

COVER DESIGNER

Clive Davis

PRODUCTION

Patrice Wohlmann, Mal Burgess

ADVERTISING PRODUCTION

Anthony Macarounas

CIRCULATION MANAGER

Michael Prior

PUBLISHER

Michael Hannan

ADVERTISING MANAGER

Selwyn Sayers (02) 693 9734

HEAD OFFICE - EDITORIAL

180 Bourke Road, Alexandria, NSW 2015

P.O. Box 199, Alexandria 2015

Fax number: (02) 693 6613

Reader Services: Phone (02) 693 6620

Subscriptions enquiries: phone (02) 693 9751

Book Shop enquiries: phone (02) 693 9751

INTERSTATE ADVERTISING OFFICES

MELBOURNE: 504 Princes Highway, Noble Park,

Vic 3174. Phone (03) 795 3666.

Fax: (03) 701 1534, Nikki Roche.

BRISBANE: 26 Chermerside Street, Newstead,

Qld 4006. Phone: (07) 854 1119.

Fax: (07) 252 3692, Ken Yates.

ADELAIDE: 98 Jervois Street, Torrensville, SA

5031. Phone: (08) 352 8666,

Fax: (08) 352 6033, Mike Mullins.

PERTH: Allen & Associates, 54 Havelock Street,

West Perth, WA 6005. Phone: (09) 321 2998,

Fax (09) 321 2940, Tony Allen.

NEW ZEALAND: 63-73 View Road, Auckland,

New Zealand. Phone: (09) 443 0250,

Fax: (09) 443 0249, Advertising Coordinator

UNITED KINGDOM: John Fairfax & Sons (Aust),

12 Norwich Street, London, EC4A 1BH.

Phone: (71) 353 9321, Fax: (71) 583 0348

ASIA: Headway Media Services Ltd, Room

2101, Causeway Bay Centre, 15-23 Sugar

Street, Hong Kong. Phone: 516 8002,

Fax: (862) 890 4811, Adrian Batten.

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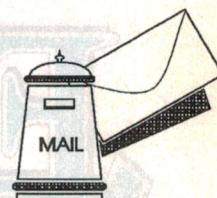
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LETTERS TO THE EDITOR



Valve amplifier — why?

I have been a long time reader of *Electronics Australia*. I am very disappointed regarding your comments re the above project. From a technical point of view, the sound comments section of the article is rubbish. Of course the amplifier has a 'warm sound' — it describes distortion products perfectly. However, your comments are the ones that I found to be most distressing (Editor's note), for the following reasons:

1. Second para, Editor's note. You are joking, how you can possibly say that this amplifier gave a good account of itself by modern standards is beyond me. I ask you to look at the distortion and RMS power specs. These are not even powers of 100 and some cases 1000 near those of MOSFET amps in the same price range. Your statement is misleading and wrong.
2. Your listening test comments remind me of those given for those 'special speaker cables'. In fact your opinion, remember this is a \$1000 kit, of the performance of this amp is so biased towards the kit one must wonder just what your involvement in this is. These are very, very ordinary specs by modern standards; great for valves, but we are not just talking about valves.
3. I must feel concerned for younger readers who may not have the technical judgement to see this amp for what it is. These readers may be swayed to sacrifice and pay for this kit. You give no warnings in this regard, these people may believe that they are getting something special, my goodness me.

I have been reading your magazine for well over 20 years and this is the biggest load of rubbish that I have read. In times of recession, \$1000 for a 40W amp is a joke, more so with the specs this has. Six pages of rubbish and more to come. I don't even want to read further. I ask you to reflect on the technology that \$1000 could buy.

John Seibright,
Erskine Park, NSW

Comment: You are of course, entitled to your opinion, John, but we published the project concerned because we've had numerous requests for information on the

design and construction of valve amplifiers — as well as for information on the availability of suitable components. Believe it or not, a significant number of people are not entirely enamoured of MOSFET amplifiers, despite the impressive figures these achieve on instrument tests; hence the interest in both valve amplifiers, and those which use either modest amounts of negative feedback, or none at all. We believe that it is NOT our role to prevent these people doing what they wish, but rather to provide whatever helpful information we can. We have no connection with Mr Tan, and published the articles purely for the reader interest; in view of the effort he has obviously made to source the components needed for the kit (any of which he will supply separately), we believe his kit price is quite reasonable. Have you seen the price of complete valve amplifiers lately?

Dolby delay: yes!

Since the days when your magazine was known as *Radio & Hobbies*, I have been putting together odd circuits, the latest one being the January 1992 'Dolby Surround Sound Decoder'.

You mentioned in this article the 'delay' section was eliminated due to cost and complexity. On speaking with a number of friends who have in fact, built the processor, all have now voiced the opinion that the delay section should be incorporated.

May I put it to you: what are the chances of seeing a printed circuit of this 'delay section' in *EA* in the near future?

I feel the processor is an excellent little unit which deserves that quality added extra to make it 100%.

Mark Matuschka,
Wahroonga, NSW

Comment: We're looking into it, Mark, and hope to be able to describe a suitable design soon.

ELF radiation

I refer to the Construction Project: 'Gaussbuster — a low cost ELF radiation detector' published in the July 1992 issue of *Electronics Australia*.

In this article, the following statement is made:

The World Health Organisation has

adopted the International Radiation Protection Agency (IRPA) guideline of 1000mG (i.e., one Gauss), whereas the Victorian Health Commission has concluded, on the basis of a number of overseas studies, that fields as low as 3mG may be associated with a doubling of the rate of childhood cancer.

This statement is not correct. The Health Department Victoria has never concluded that fields as low as 3mG may be associated with a doubling of the rate of childhood cancers.

The Health Department Victoria funded the University of Melbourne Statistical Consulting Centre to carry out a meta analysis of the existing epidemiological studies on a possible association between exposure to powerlines and cancer. They concluded that fields as low as 3mG may be associated with a doubling of the rate of childhood cancer. The Health Department did not support the Consulting Centre's conclusion.

The National Health and Medical Research Council has endorsed the interim IRPA guidelines, which recommend the 1000mG level. The Health Department Victoria supports the NHMRC on this matter.

These guidelines recommend that members of the public should not be exposed to magnetic fields greater than 1000mG (0.1uT) for periods up to 24 hours per day. These guidelines also state:

The exposure limits are based on established or predicted effects of exposure to 50/60Hz fields. Although some epidemiological studies suggest an association between exposure to 50/60Hz fields and cancer, others do not. Not only is this association not proven, but present data do not provide any basis for health risk assessment useful for the development of exposure limits.

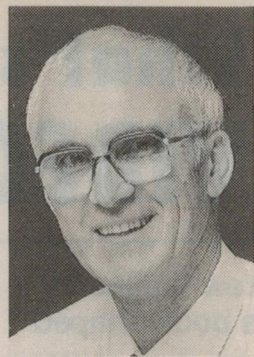
Current laboratory studies are testing the hypothesis that 50/60Hz fields act as, or with, a cancer promoter. These studies are still exploratory in nature and have not established any human health risk from exposure to the fields.

These limits have been developed from present knowledge, but there are still areas of research where questions have been raised that need to be addressed. A major research effort to supplement our knowledge on the health consequences, if any, of long term continuous exposure of humans to low-level 50/60Hz fields is required.

I would appreciate if you could inform your readers of this error in the next edition of *Electronics Australia*.

Trevor Boal Ph.D.
Radiation Safety Section,
Health Department VIC.

EDITORIAL VIEWPOINT



The real future for HDTV

It's been very interesting to see the trend of recent press reports and comment on HDTV developments, especially those coming from Europe. Not all that long ago, the Europeans were heavily in favour of their planned D2-MAC/HD-MAC progression; but the tide of opinion now seems to be swinging towards sticking with standard PAL and other existing 4:3 transmission formats, and waiting until a fully digital high definition system is developed. This is very much in line with the way the Americans have been thinking all along — despite intense lobbying by both Japan and Europe.

According to Frank Ogden, the editor of UK magazine *Electronics World + Wireless World*, the UK's National Telecommunications Labs at Crawley Court has already demonstrated high resolution digital TV using a compression system which squeezes the signal into a standard terrestrial TV channel. This is ironic, when you recall that the same research labs developed the original MAC system — when they were part of the former IBA.

I don't know about you, but I really do think that it would be far better to stick with our existing systems until a suitable all-digital HDTV system is fully developed and ready to roll. It's becoming more and more clear that the long-term future of TV in general is going to be fully digital, and that digital systems are likely to be fully operational by 2005, if not sooner. So analog-based HDTV systems were clearly only ever going to be an interim technology, and a short term one at that.

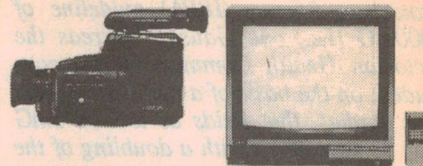
It's also true that the supposed 'push' for HDTV systems has not been coming from the world's TV viewers, but from the manufacturers and marketers of hardware and software. The vast majority of viewers everywhere seem to be quite happy with the reception quality from existing PAL, NTSC and SECAM transmissions — and even the significantly degraded quality from the 'standard' grades of VCR. Only a relatively small percentage have as yet shown real interest in things like 16:9 'widescreen' sets, S-VHS/Hi-8 video, and laserdiscs — all of which offer a significant increase in picture quality, albeit at a price.

Rather than waste time, money and other resources on development of interim broadcasting technology like MAC and HD-MAC, it would therefore be far better to wait a little while longer for the *real* next generation of TV and video based on digital technology. Particularly as it's now looking likely that this technology will finally be able to deliver true *global* compatibility. For example a paper by MIT researchers published in the *SMPTE Journal* (January 1992) described how a digital HDTV system can be designed to have 'open architecture', so its signal can be transmitted, decoded and displayed in a wide variety of formats and resolutions — rather like the way computer systems can currently display images in CGA, EGA, VGA, S-VGA and XGA formats depending on the available hardware. The same 'digital hierarchy' concept was developed further in another paper, in the July 1992 issue of the same *Journal*.

That's the way we should be heading, surely. And that's why we shouldn't be rushing to saddle ourselves with any kind of short-term analog HDTV system.

Jim Rowe

What's New in VIDEO and AUDIO



New Philips TV is book-shaped

For those not able to afford its new wide-screen (16:9 aspect ratio) colour TV receivers, but who still want a set that is out of the ordinary, Philips has released

the novel 'Book TV' illustrated. For reasons best known to the designers, its distinctive cabinet has been shaped to resemble a partly-opened book...

Despite the impression given by the relative sizes of set and model in the picture, the new model 14GR1228 is in fact

not a monster — the picture is a modest 34cm (14") on the diagonal. It features a full-function remote control, on-screen display of channels and functions, and a swivel base with vertical tilting.

Expected selling price for the set is around \$649.

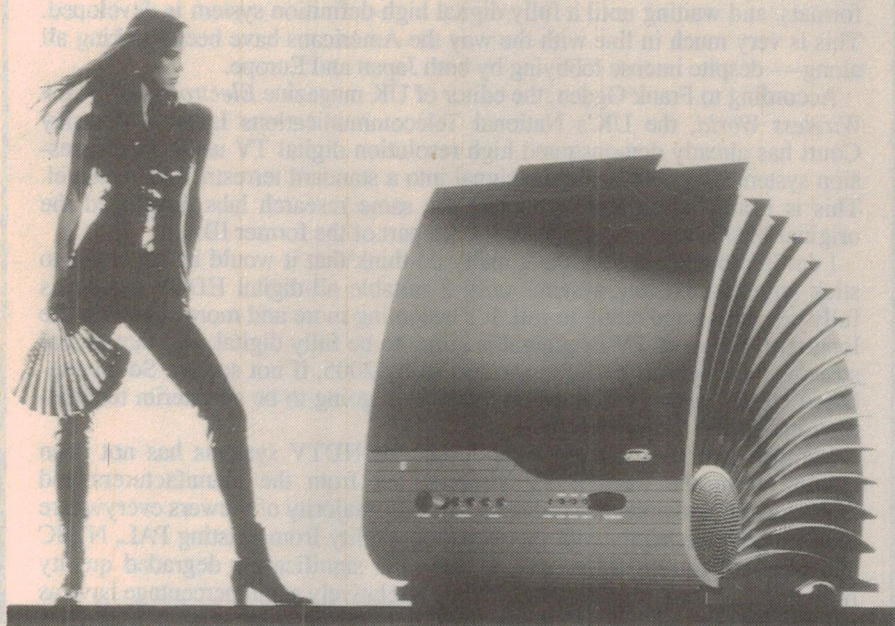
Active add-on speaker system

The compact yet high performance 'Persona One' personal speaker system from Monster Cable is suitable for a remarkably wide range of applications from portable CD and cassette players (including DAT) to VCR's and television, as well as CD-ROM and computer workstations.

Because of its inbuilt amplifiers, the Persona One can be hooked up in minutes to provide crisp clear stereo sound in a variety of situations, without the usual limitations of small speakers.

The ARS Ambience Recovery System is claimed to recreate the presence of the original recording without any time delay or signal processing and is said to be ideal for the dramatic special effects of your favourite movies when connected up to a television or video cassette players.

Priced at \$399, the Persona One is available from Australian distributor



New mini music system from Yamaha

Yamaha's new CC-5 mini music centre system offers the performance and features of Yamaha's YST-NC1, but with a new sophisticated look.

With a width of only 277mm, the CC-5 is a particularly compact unit. It incorporates an integrated amplifier, CD player and double cassette player with the proven performance of Yamaha's AST active servo technology speaker system.

Surprisingly for such a compact unit, the CC-5's integrated amplifier provides 50W RMS of power output per channel — making it quite a powerful unit.

This is combined with an abundance of features, including full system remote, motorised volume control, five inputs and full bass and treble control. However, with Yamaha's reputation in



Dolby Surround Sound Processors, it is this system's three mode sound processing capability which is the distinguishing feature.

All this is combined together in a stylish pearlescent grey body, making it suitable for either lounge or bedroom.

The short cable connection between the three units means one powerpoint is all that is required to get the system up and running.

Retailing at \$1499, the CC-5 represents a powerful and extremely versatile unit with an air of class.

Convoy International of 400 Botany Road, Alexandria 2015; phone (02) 698 7300.

Marantz distributes other hifi brands

Marantz Australia, the specialist hifi division of Philips Consumer Electronics, has completed negotiations to acquire the exclusive Australian distribution rights for Mordaunt-Short, Creek Audio Systems, Epos Acoustics, Rega Planar, Standesign and Phoenix Gold products.

These brands were formerly distributed by Concept Audio, and Concept founder Derek Pugh is working closely with Marantz both to continue their development and to assist in the acquisition of complementary products.

Matsushita markets DCC in Japan

Matsushita Electrical Industrial Co Ltd of Osaka, Japan began marketing its first digital compact cassette (DCC) deck in September. Initial production of the Technics RS-DC10, will be limited with exports to Australia and other countries following later. The price in Japan is around 135,000 yen.

The digital cassette deck is compatible with the new DCC audio format, and features hardware and software designed to substantially improve the quality of audio tape sound. DCC employs the latest digital signal processing technology and a multi-channel digital thin film head.

Dual cassette deck from Kenwood

Kenwood has introduced its KX-W8040 auto reverse double cassette deck, with performance claimed to exceed that of many competitive 'flagship' single decks.

The KX-W8040 boasts Full Logic IC Control for 'feather touch' operation and dual bi-directional recording. Simultaneous parallel recording is also possible in both A and B decks with a simple one touch parallel REC key operation.

In addition, when used with other 'synchro' configured units such as Kenwood's CD players, the record mode of the deck will synchronise to the CD and will stop automatically when the CD comes to an end.

The KX-W8040 provides both Dolby B and C noise reduction systems which can reduce unwanted tape hiss as much as 20dB (Dolby C). Additionally, the KX-W8040 features the more recent HX-Pro headroom extension system that adjusts the recording bias to extend the high frequency headroom.

Akai's new Hi8 camcorder

Akai's new PV-MS08 Hi8 camcorder boasts a number of significant features that are normally only found in professional units, including a 420,000 pixel 1/3" CCD that permits shooting down to 3-lux light conditions — the equivalent of a pocket torch.

The PV-MS08 includes an eight times power zoom that incorporates a servo focusing ring. The Auto Range and Auto Focus modes focus in from infinity to close up in a continued smooth action even when using the macro range.

The zooming speed is proportional to the finger pressure on the button. In addition the Auto Chase Focus (ACF) feature will follow a moving object keeping it in focus continually whether it is retreating or advancing towards the camera. Designed for two speed operation, the

PV-MS08 can shoot up to three hours on an ES-90 tape. The usual loss of detail in extended recording mode is dramatically reduced thanks to I-HQ technology. This unique technology also provides a noiseless still and slow motion picture, ideal for examining sporting techniques.

A choice of title generators is offered. Hand written titles or illustrations can be superimposed with the Digital Superimposer or up to 48 alpha numeric characters can be recorded at any one time via the character generator. For a wider selection of recording functions the PV-MS08 offers an 'insert recording' feature that lets the user insert a scene on a tape that's already recorded.

An 'interval recording' feature automatically shoots one frame every 5s, 10s, 30s 1min, 2min or 5min and additionally a 'one shot' recording feature lets the user operate the PV-MS08 as a still camera.



This allows the user to record at much higher levels of the upper frequency material without distortion.

In addition to featuring an Auto Selector mode which will automatically select for Normal, High, and Metal Position tapes, the KX-W8040 also features Auto bias which takes into account the often considerable differences in performance between individual tape formulations.

Kenwood's Auto Bias 'fine tunes' and samples each tape (Normal and High

Position tapes only) and determines the optimum bias setting automatically. Technical specifications include a frequency response from 20Hz to 20kHz (metal +/- 3dB); S/N 72dB (Dolby C); harmonic distortion less than 0.6% (reference '1kHz 0dB 3rd harmonic type I); and wow and flutter less than 0.06% (WRMS).

The KX-W8040 has an RRP of \$649, is covered by a three year parts and labour warranty and is available at selected Kenwood dealers and department stores. ♦

Video & Audio:



SONY'S V6000 HI8 CAMCORDER

Weighing 3kg and nearly half a metre in length, the new Sony V6000 is definitely not for 'mum and dad' domestic home movie making. Nor would it be anything more than a nuisance, for the traveller on a world tour. But for the semi-professional who wants to make really high grade video programs on a limited budget, it's the camcorder they've been waiting for...

by **BARRIE SMITH**

Sony Corporation are giving themselves major problems in market segmentation: in terms of models, their 'young upstarts' are getting smarter, while the older and more sedate models are experiencing a slimming treatment.

The company's consumer cameras in Hi8 format are improving in quality, and incorporate such useful aids to post-production as time code and digital picture effects.

At the other end of the scale, they have also been producing camera and dockable record backs in the format for professional use, with the aim of sup-

planting the 3/4" SP format; now they've also launched a one piece camcorder for the same level of user. Meanwhile, the vastly more expensive — and larger — Betacam SP and 2000 camera/recorder continue to dominate the top level of professional video making.

Price differential

Price is, of course, the determining factor. A Betacam SP combo nudges \$30,000 (ex tax); a Hi8 integral camera/recorder levels out at \$12,500. If you're a video producer, and your release media is of no higher level than

the common-or-garden VHS cassette, it's hard to justify the considerable difference.

Similarly, if you're a video producer and your business centres around weddings, fleshed out with the occasional business video production — all released as VHS cassettes — it's tempting to look even lower than the 'pro-level' Hi8 machinery.

Enter the Sony V6000, with a price of just over \$4000 (ex tax) or \$4999 retail. In Hi8 format, with RCTC time code, PCM sound and timebase correction.

Why such a major difference? Well,



The side control panel. Why couldn't the audio section be given two separate channel pots?

the \$12,500 models (and above) all have three-chip CCDs, 700 lines of horizontal resolution from 1/2" or 2/3" chips and are able to accept interchangeable lenses.

The V6000 tops at around 400 lines from its 1/2" single-chip CCD, and has a fixed 10-times zoom.

One CCD vs three

Sony believes that professional users are steering more and more away from using single-chip cameras for their productions. Most buyers find there is little price advantage any more in purchasing a single chip model, plus the size of the three-chip models has shrunk.

For broadcast use, Hi8 has had a checkered career, with many station engineers expressing reservations about the format's quality. However, once original footage has been bumped up to 1" or SP formats, the upstart's humble origins are quickly lost.

But single chip Hi8 camcorders like Canon's EX1 and the Sony V5000 (the V6000's predecessor) have cut a swathe through those creating productions which have a life of no higher ambition than general public viewings on VHS.

One interesting case is Sydney cinematographer John McLean, who invested in a Sony V6000 to produce a series of documentaries in a poorly-developed part of SE Asia.

Being obliged to shoot and record sound single-handed, McLean was also sage enough to realise that a (relatively) small consumer video unit, like the V6000, attracts less official attention at points of entry and on location.

On its introduction in late 1990, the V5000 stunned the market. Now, the upgraded model V6000 offers the same basic bag of features, but with a 10X zoom, stepped iris with viewfinder display, RCTC (see data box) and video gain control as additions.

If you're a home movie maker, the V6000 is definitely not for you; nor would it be anything more than a hulking great nuisance for the traveller on a world tour.

In the first place, there are so many bells, whistles, knobs and buttons that the chances of the average person shooting anything more than an hour or two of the translucent lens cap are minimal.

In the second, 3kg is a lot to lug around on a bus tour, and a length of

nearly half a metre a touch too expensive for an overnight bag. Besides, a tripod is essential to support its weight and bulk for shooting.

V6000 features

The fixed 10x zoom is a product from the 'old school' — meaning its optics did not undergo the shrinking process which has occurred with the mini palmcorder. Because of this its focus can be manually controlled with the fingers(!), as can the zoom and the macro functions.

As expected, the TTL AF system can be defeated by very bright or dark subjects, low contrast scenes, horizontal stripes and other regularly patterned scenery.

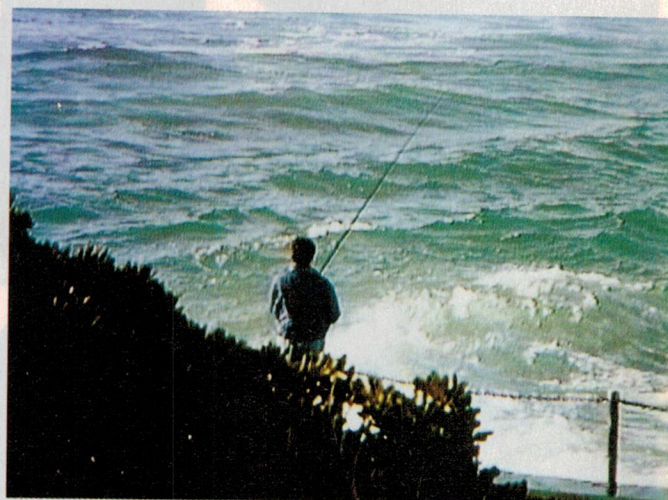
Serious video makers should use 'manual' focusing on the majority of occasions — with little fuss and no more than a 130° swing from full close (1.3 metres) to infinity. Macro (as close as 1cm), via the little green 'swizzle stick,' is only available at the 8mm wide setting — a measure of the lack of 1990's sophistication in the optical design.

Manual iris control permits the lens to be completely closed down or fully

Sony's V6000 Hi8 Camcorder



A long shot taken with the zoom at the 8mm wide end. The definition is quite acceptable.



The same scene as at left, fully zoomed in at 80mm.

opened. The f-stop readings are shown all the way — from f/19 right up to f/1.8. Aside from the iris button being too slippery, the system works effectively.

With its help I came to the conclusion the CCD could be effectively rated at ISO 200 (in film terms), confirming the 3-lux low light level claim.

Should this be not enough, an 18dB boost in video gain can be switched in — at a not inconsiderable penalty in noise.

I counted 68 controls on the unit, plus 12 input/outputs. An LCD panel, a pair of VU meters and a tiny speaker occupied the



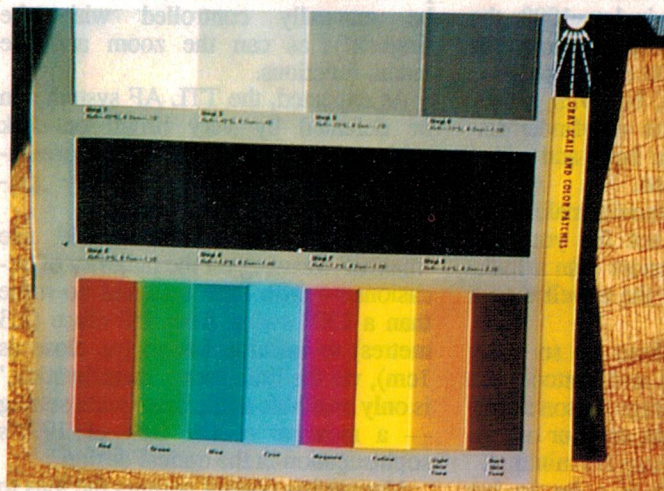
The 2x digital zoom switched in — effectively 160mm.

remainder of the available real estate.

The generous LCD panel is inset immediately behind the zoom. This displays such items as time code readings, date/time, index mark and auto/manual mode setting.

Oddly, such a healthy-sized panel does not show colour temp nor shutter speed settings — which could help videographers wishing to work via the (supplied) remote control unit.

The latter is a useful device that permits a number of operational functions to be triggered: stop/start, record, zoom, various replay



Above: The solarising effect — at level 2. Low definition points to small capacity of field store memory.

Left: The crucial test: Kodak's colour chart. There's surprisingly good separation between colours, except for the old problem - red.

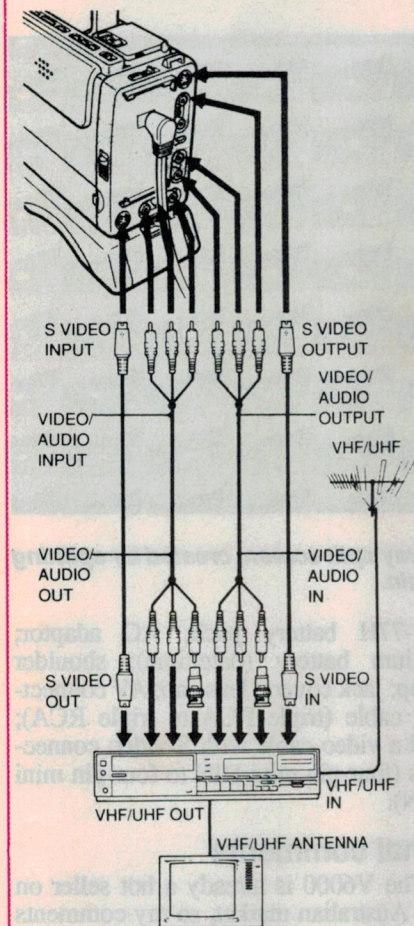


Fig.1: Range of inputs and outputs available on the V6000. The unit can also be used as a recorder, accepting line inputs.

functions, index marks, data superimposition on an outboard TV screen and various digital picture trickery.

Remote operation enables the use of the unit not only as a remotely recording camera, but as a replay unit in a multi deck environment.

Remote beam acceptance is liberal — 30° laterally and 15° in the vertical from centre — from directly ahead of the unit and from the left side. Operational distance is a stated five metres, but I found that triggering the V6000 from 10 metres was possible.

White balance can be achieved relatively simply by fixing the white lens cap in place and pressing the appropriate button. Balance can be set by aiming the camera's lens at the light source or the scene.

Special effects

Many buyers who are 'into' visual effects will throng to the V6000 for its armory of digitised picture manipulations. The camera's field memory is responsible for the trickery. Here's a catalog:

The normal fade in and out is supplemented by a dissolve effect, allowing one scene to be blended into another. A one-second 'take' can be recorded every minute (for time-lapse effects — flowers growing, etc.)

Six frames can be shot at user-selected intervals, for 'stop motion' scenes.

Two pages of title or high contrast graphics can be captured by the camera, stored and colourised. These can be superimposed over live action while recording — separately or as a pair. Neg/pos rendering is possible, and a repertoire of scrolls up and down over the picture achieved.

8 mm video tape format

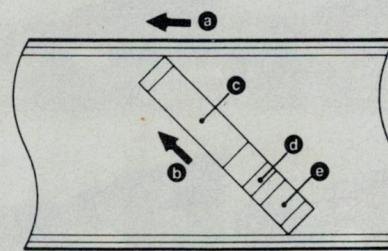


Fig.2: The basic 8mm tape format.
(a) Tape transport in lateral direction
(b) Head travel in helical path.
(c) Video and audio (AFM stereo) — known as the 'standard track'.
(d) Index, RCTC and data code (time, data, etc) path.
(e) PCM stereo audio.

Vignette effects, holding a live scene over another, can be made. A digital zoom is available, with a 2x factor. This can be accessed both in recording and on replay, effectively giving a 4x zoom.

Strobe, solarisation, noise reduction, stop motion, flash motion and nine-way split screen effects are also available.

These have three settings of degree and can be used in record and again in replay, effectively multiplying the result. In the case of the nine-way split screen, when replayed and split again the resulting screen is 81 repeated images!

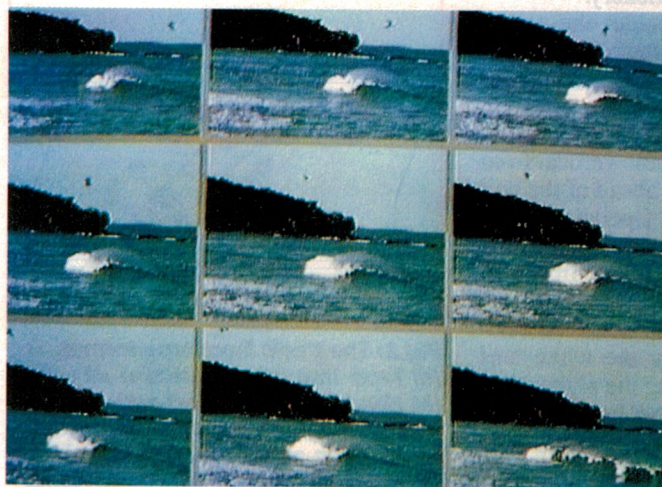
The audio side

The standard onboard mike is a one point, uni-directional stereo model. Its signal can be recorded onto both the

CCD-V6000E - SPECIFICATIONS

Format	Video Hi8	Viewfinder	Black and white electronic 0.7 inch
Video recording system	Rotary two heads	Lens	f/1.8 8-80mm variable speed
Audio recording system	Helical scanning FM system	Shutter speeds	power zoom
	Standard: rotary head/	AF system	To 1/10,000 sec
	FM system	Colour temperature	Through the lens
	(2 channels) PCM: 2 channels		Indoor 3200K;
Microphone	Electret condenser		outdoor 5800K Manual setting
Narration mike	X2 uni-directional stereo	Minimum illumination	3lux at f/1.8
PCM sampling frequency	Electret condenser, mono	Illumination range	3 - 100,000lux
PCM frequency range	31.5kHz		(0.3 - 9294 ft-candles)
Dynamic range (PCM)	20Hz - 15kHz	Recommended illumination	More than 100 lux
Wow and flutter (PCM)	More than 85dB		(9.3ft candles)
Video signal	Less than 0.005% RMS	Aperture	Auto and manual
Tape speed	PAL colour: CCIR standards	Power requirements	6V (battery pack) 7.5V (AC adaptor)
	SP: Approx 2.0051cm/sec	Power consumption	12W camera recording
	LP: 1.026cm/sec	Dimensions	Approx 190 x 235 x 430mm
Fast forward/rewind time	Approx 7 min (90mm cassette)		(W x H x D)
CCD	1/2 inch.	Weight	Approx 3kg (excl battery, lithium
Resolution	470,000 pixels total;	Price	battery, tape, jack cover)
	440,000 effective		\$4999 (RRP)

Sony's V6000 Hi8 Camcorder.



Multi mode — a nine-way split screen. Note the position of the seagull, indicating progressive capture of frame.



Nine times nine: an 81-way split screen, created by splitting the nine-way screen again.

stereo PCM track and the standard monaural track.

Being a discrete pair of channels the PCM signal may be re-recorded at a later date, leaving the picture and AFM track unaffected. In this operation, the picture may be monitored in playback. A two-channel mix to the PCM track can be made by inputting one signal via the left channel and another via the right.

A flip-out narration mike is inset just beneath the VU meters, close to the operator's mouth. In circuit, this signal lands on the standard AFM track and replaces the PCM.

Should an external mic be connected to the appropriate stereo inputs, the signal is again directed to the PCM and standard tracks. If the narration mic is switched in at the same time, its mono audio is mixed with the external's. There is provision also for an outboard mono narration mic.

PCM quality is high, giving hash-free replay with a clear high frequency response — but lacking in bass. The system picks up low level bumping noises

from the auto focus motors, but surprisingly little from the power zoom.

Recordings can be made from a VTR or RF aerial source and input to the V6000 via the RCA terminals, RF (via an adaptor) and S-video inputs. The insert edit function can be brought into play for glitch-free edits.

Timebase corrector

For many users, this feature alone will swing them to the V6000.

As consumer camcorders have shrunk in size, so has the incidence of picture 'jitter' risen. Smaller head drums have been the cause. Timebase fluctuations due to uneven head rotation and variations in tape speed are introduced. When jitter gets to an extreme level the image becomes unstable and a swaying or bending motion becomes noticeable.

The V6000 uses a field memory to output a stable and synchronised signal with its timebase restored and corrected. Incidentally, the V6000 comes with remote control and two AA batteries;

NP-77H battery pack; AC adaptor; lithium battery (date/time); shoulder strap; jack covers; lens cap; AV connecting cable (triple RCA to triple RCA); and a video cable with S-video connectors (four-pin mini DIN to four-pin mini DIN).

Final comments

The V6000 is already a hot seller on the Australian market, so my comments are not going to dent that achievement by very much. However, some things need to be said:

The power drain is enormous. The NP-77H battery will drive the unit in record mode, with all auto systems in operation, for little more than 10 minutes. If away from 240V, serious workers will need to invest in a battery belt or heavy duty lead-acid gel battery.

Many of the controls could do with finger-sensitive texturing, and benefit from a little more prominence by raising them from the overall surface.

The stereo record section should have been equipped with separate L+R channel pots.

The picture quality shows excellent colour separation, with only a little bleed coming from the red sector. Definition is equal to any single-chip Hi8 camera on the market — on replay it was a surprise to see the picture defeating that from normal broadcast channels! There was a little cross-colour showing in some areas, though.

The instruction book is far too simplistic — but then I guess the company really wants you to buy the \$12,500, job with comprehensive book to match!

Rewriteable Consumer Time Code

Rewriteable Consumer Time Code or RCTC is the only mainstream consumer timecode system which is backwards compatible and allows a prerecorded tape to be coded.

When the Video 8 tape format was designed, an area between the video track and the PCM audio track was set aside for the RCTC, data code (date and time) and index signals. RCTC is recorded as digital data in this area of the tape. The RCTC information is transmitted as serial data through the Control L (LANC) connector, which is how it is read by an edit controller. Note that RCTC is not compatible with the institutional 8mm time code system, also produced by Sony.

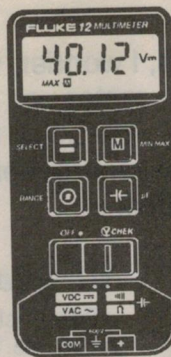
RCTC indicates the absolute position to the hour, minute, second and frame. The code can be written over a pre-recorded tape and may be displayed on the TV screen while editing or copied to another tape. There are at least six edit controllers available which use RCTC.

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Vac	2.0%+2	2.0%+2	2.0%+2	2.0%+2	1.0%+2
Ohms	0.5%+1	0.5%+1	0.5%+1	0.5%+1	0.4%+1
Adc	NA	1.5%+2	1.5%+2	1.5%+2	0.5%+2
Aac	NA	2.5%+2	2.5%+2	2.5%+2	1.5%+2
Frequency	NA	NA	NA	NA	0.01%+1

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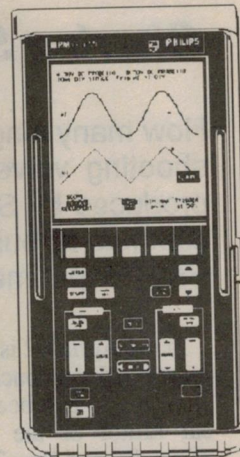
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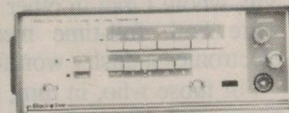
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When I Think Back...

by Neville Williams

Charles Slade and 'Calstan' meters

How many long-time radio engineers, servicemen and hobbyists, I wonder, will remember trouble-shooting valve equipment with an Australian-made 'Calstan' meter, or other test equipment produced by Slade's Radio, of Croydon NSW. And how many others will have purchased radio cabinets or built-up receivers from the same source? Or an FM tuner/receiver in the days of the PMG 'experimental' FM transmissions? Maybe you'd almost forgotten...

In the April '92 issue (page 47, col.2) I mentioned that, back in the 1920's, a Mr C.W. Slade had been appointed Technical Editor of the magazine *Radio in Australia and New Zealand*.

It had been taken over, shortly before, by Wireless Newspapers Ltd and had thereby become, at least temporarily, a stablemate of our own predecessor *Wireless Weekly*.

More or less prompted by the remote (publishing) family connection, I speculated whether this C.W. Slade was the same Charles Slade who was later involved in the manufacture of Australian-made test equipment, under the trade names 'Slade', 'Slade-Paton' and 'Calstan'.

To my somewhat rhetorical question, I received a resounding 'Yes!' from Colin MacKinnon (VK2DYM) of Glenhaven in NSW, who appears to have assembled an impressive personal database on Australian radio and related publications. More about that later.

A letter also arrived from Syd T. Clark, now retired at age 72 in Frankston Vic, whom I met in other days when we were both full-time members of the electronics industry workforce.

For those who, in turn, may speculate about Syd Clark, he mentions having served in the Australian Navy during WW2 and, for a period, in the Standardisation Section of the Dept of Defence.

He also mentions a job inspecting amplifier equipment installed in Victorian schools, and being employed by PMG Technical Services in Sydney looking after the ABC's 'experimental' FM transmitter, originally

built in the PMG's Melbourne Research Laboratories.

I subsequently met Syd when he was representing Electronic Industries Imports, of Melbourne. In Navy days, he had been a qualified telegraphist and is still an active amateur (VK3ASC), most likely to be found on weekdays at 08.30 EAST, on 7065kHz SSB.

Syd Clark says that he knew Charles Slade well, having served alongside him in the RAN during WW2. From these and other sources, a reasonably definitive word picture has emerged of the Charles W. Slade in question.



Fig.1: Charles ('Cap') Slade, as pictured in *Wireless Weekly* for May 24, 1935 when he had just left for an overseas trip. Framed pictures displayed in his Croydon headquarters mostly showed him in his naval uniform.

RN 'wireless boy'

Way back in 1909, I understand, he joined the Royal Navy as a 'wireless boy', subsequently rising to Petty Officer. Without knowing his exact year of birth, it would probably have been in the early 1890's.

Petty Officer Slade, RN, subsequently spent three years in Australia serving on HMA submarine J7, before being re-posted to the UK to work as a telegraphist.

He returned to Australia as a civilian in 1923 and took a job as an engineer with W. Harry Wiles, in those days a leading Sydney retailer of wireless components. A promotional item in the *Australasian Wireless Review* for January of that year gives Wiles' address as 60 Goulburn Street, Sydney — which would have been a prime retailing site at that time, within easy walking distance of Central Station, then the common terminus for interstate, country and suburban trains.

In the write-up, Harry Wiles is said to have been a keen experimenter over many years, carrying at the time (I quote) 'a large stock of double and single headsets, loose couplers, honeycomb coil holders, variometers, variocouplers, filament resistances, condensers and plates, terminals, switches and switch points, dials and knobs, crystal detectors, insulators and grid leaks. In fact, every requirement of the experimenter is catered for'.

Charles Slade had picked a good year to come to Australia. It was the year in which public broadcasting was launched, and he found a wireless workplace where it was all happening,

as far as experimenters were concerned. He must have made a good impression because, within two years, he had gained a position as Technical Editor with Wireless Newspapers Ltd, at the time publishers of not only our predecessor *Wireless Weekly* and *Radio in Australia and New Zealand*, but also the *Daily Telegraph Radio Supplement* (1925-26).

Following this stint as a technical journalist, he is said to have launched his own company in late 1926: 'Slade's Radio', selling both components and complete 1920's-style receivers. This was presumably from his long-standing residential address — a large two-storey house in suburban Croydon, with enough surplus space ultimately to accommodate a modest factory.

Slade's Radio

He did well enough to become involved, in 1931, in the manufacture of test equipment — ostensibly 'high quality' in the sense that it was intended to be a cut above the elementary meters and gadgets that epitomised a lot of service work in the battery set era.

That he was serious about the venture was evident from the fact that he travelled overseas to investigate world trends. This was at a time when travelling abroad was a very time-consuming exercise.

Thinking back on those days, when I was still a schoolboy enthusiast in the making, I remember acquiring a couple of 'Readrite' meters from my grandfather, who couldn't think of anything better to do with them. Rather like

a pocket watch with flying lead(s), they were moving-iron types, similar to the then automotive dashboard instruments and with no special attributes to confirm their ability to 'read rite'!

In fact they were so limited in their application that I still preferred to perform continuity checks with a dry cell and a pair of headphones, listening for the rewarding click that signalled a continuous circuit — even if of high resistance.

Higher quality moving coil, multi-range meters were available in brands such as Weston and Jewell, but the more accessible ones — for a school kid — were still too insensitive for general testing.

Once I became seriously involved in radio, one of my first major investments was — yes — a 'modern' fan-shaped moving coil meter, with a full-scale sensitivity of one milliamp and bearing Charlie Slade's brand 'Calstan'.

It was to become the basis of a 1000 ohms per volt portable multimeter, which I set about building up from scrap plywood, leatherette and a black bakelite panel, hand-lettered with white lacquer. I gave it away some years ago to a young relative but, in chatting recently to Arthur Spring, designer of the once popular Precedent B&W TV receivers, he exclaimed "I still have a meter just like that under my bench"!

It says something for Calstan ruggedness that they survived all those years — because, in the distant 1930's, we lacked the know-how and the technology to protect sensitive meter movements from inadvertent overload. If you bent the pointer, you dis-assembled the case and gingerly straightened it again!

Why both Arthur and I should have chosen Calstan I'm not sure, but it may well have been a matter of chance. As I recall, Australian-made Paton ('Palec') meters were on sale about the same time, so similar that they could easily have been the end product of shared technology or a joint production facility.

Syd Clark's understanding is that Charles Slade had, in fact, worked for a time in partnership with J.W. (Jack) Paton, and Colin MacKinnon apparently shares the same impression. I have not, however, been able to clarify the exact details or duration of any such association.

The pre-war years

Slade's own large two-story house-cum-factory has since been described to me by a retired engineer as 'a vaguely Spanish conglomeration of pillars and arches'. Another described it as a



Fig.3: A Calstan valve analyser, intended to operate in conjunction with the multimeter shown in Fig. 2. The name 'Calstan' was said to be a contraction of 'Calibrated to Standard'.

'huge, sandstone structure, more reminiscent of an English country castle than a house in Croydon'. Both stressed that it was a very old building, with out-buildings and its own 'beehive' water well, indicating that it had been erected before reticulated water was available in the area.

Meter movements aside, it was there that Charles Slade manufactured mains-powered receivers throughout the 1930's — some unbranded, some to be sold as 'Calstan', others for 'a Mr Alberti' to be marketed under the 'Zenith' label.

That Slade was still involved in test equipment is evidenced by a full page advertisement in *Radio and Electrical Retailer* for July 27, 1939.

Fig.2, from the advert, shows a push-button Calstan multimeter which was available in three models: model 140, DC only; model D141, convertible to DC/AC; and model 141, AC/DC.

Fig.3 shows a companion instrument for valve evaluation, with a multiplicity of sockets, adaptors and switching to take account of differing pin connections.

Contemporary advertisements in the early issues of *Radio & Hobbies* indicate, however, that the test equipment field was becoming very competitive during 1939 — even before the Asian imports flooded in.

The May 1939 issue carried a full-page advertisement for Paton showing an extensive range of 'Palec' instruments. In the June issue *Radio Equipment* advised readers that they were



Fig.2: A Calstan multimeter, as advertised in 1939. It was available in three versions: DC only; DC convertible to DC/AC; and DC/AC.

WHEN I THINK BACK

distributors for both Calstan and Palec but, by September, they were offering their own alternatives, in kit form.

In the 'Xmas 1939' issue, the kits had given place to built-up 'University' brand instruments, in direct competition with the other two.

Following the outbreak of World War II, Syd says, Charlie Slade enlisted in the Royal Australian Navy where they both served on the staff of Lt. Nap Harding, Port Wireless Officer on Signal Hill, Garden Island, Sydney. It is there that Syd picked up in casual conversation some of the foregoing information.

Change of direction

After the war, Charles Slade appears to have taken up his business from more or less where he had left off, but with little or no emphasis on test equipment.

In fact, in back copies of magazines to hand, I did not come across a single post-war advertisement for Slade/Calstan meters and the like.

I did note, however, one other subsequent and unique digression — into FM (frequency modulation) radio.

Shortly after the war the Australian Broadcasting Control Board had accepted a proposal by the PMG Technical Services to set up an 'experimental' FM broadcast transmitter in each of the major capitals, (see *EA*, February 1990, p.36), to provide experience in this — to Australia — relatively new technology. Those for Sydney and Melbourne came on air during 1947, carrying a program

'split' from one or other of the ABC's existing AM networks.

The transmissions were not in any sense covert, but they were not promoted to the public-at-large and no program schedules were ever published. In fact, while the program 'split' usually favoured quality music, the content was really at the whim of the duty engineer.

Charles Slade was one of the many hifi enthusiasts who built up an FM tuner forthwith — and liked what he heard. More than that, he saw the opportunity of offering FM tuners to non-technical enthusiasts on a direct-order basis.

From a full-page advert in the February 1949 issue of *Radio & Hobbies*, Fig.4 shows a 6-valve FM tuner from Slade's Radio, housed in a 'mantel' style moulded cabinet. Priced at £25, it was promoted as a worthy companion unit to any existing high quality receiver/amplifier.

Fig.5 shows what purports to be 'Australia's first-ever FM/AM Radiogram'. Involving nine valves, it offered FM, AM and shortwave coverage, together with a high grade record changer. The price, including a special VHF dipole aerial, was £125 pounds ex factory.

Coincidentally, and as already mentioned, one of the 'techs' who had been delegated to supervise the Sydney FM transmitter and select the program feed was Charles Slade's old navy contact, Syd Clark.

Components, receivers

In a quick check through other back

copies to hand of *Radio & Hobbies*, I came across another full page advertisement for Slades Radio — itself an indication that his turnover was sufficient to support that level of expenditure on publicity. This time (April 1951) he was offering a full range of console and console radiogram cabinets, to dealers and/or private buyers.

A similar full-page advert in the December 1961 issue emphasised that, as well as cabinets, ready-built receivers were available, along with phono decks.

In between, the June 1954 issue of *R&H* carried an advert for Slade's 'most astounding achievement in 30 years' — a dual car and home radio. Able to operate from 6V or 12V DC or from 240V AC, it could reputedly be transferred from car to home use in 30 seconds. In its day, such a receiver would have been a real designer's nightmare!

Curiously, all of the adverts carried a reference to 'Established 30 Years' — which does not accord with the establishment date quoted earlier, 1926, or take account of the passage of time!

Anecdotal evidence from engineers who had occasion to visit Charles Slade suggests that, in the postwar years, he became progressively more involved in buying up new but surplus industry components which could conceivably be resold cheaply, used in kits or absorbed in unbranded receivers. Typical was a huge consignment of good quality record changers, unwanted by a major manufacturer.

It is probably for this reason that engineers and buyers from contemporary

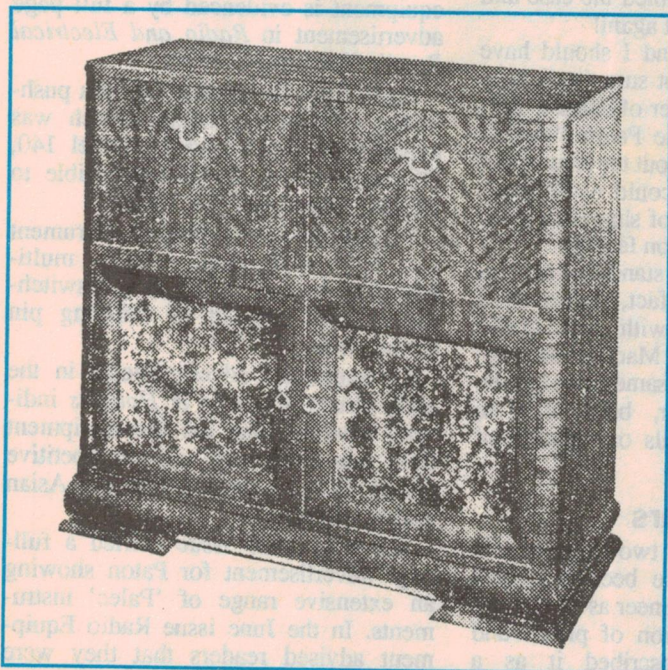


Fig.4: (above) An FM tuner offered by Slade's Radio in 1949, when the only signal to be heard was from a sole experimental FM transmitter in the major capitals.

Fig.5: Claimed to be Australia's first even AM/FM/SW radiogram, this receiver was available, on cash or terms, direct from the factory or registered Slade's Radio dealers.

companies used to visit Slade's Radio to see what was on offer. One of them indicated that, on such visits, he never addressed Slade as 'Mr' or 'Charles'. Arising from his long-standing navy background, he said, he was commonly known by his industry peers as 'Cap' Slade — an appellation that could as easily have referred to what another industry acquaintance describes as 'a shock of white hair'!

And there my story might have ended, if I had not been put in touch with Kevin Piggott, a long-time radio engineer who was involved in the final chapter of the Slade saga. Kevin heads up the Talking Machine Co (phone (02) 645 1836), a family company which specialises in old-time audio equipment ranging from mechanical music boxes to valve-based receivers and amplifiers.

The final chapter

Without knowing any of the details, Kevin said that, as Charles Slade was overtaken by age and other inhibiting circumstances, he was apparently unequal to the demands of his Croydon enterprise. He gradually dropped out of sight, and the already old premises became derelict.

Kevin Piggott became involved when those responsible for the Slade estate contacted him, presumably when they learned of his technical activities and his interest in electronics memorabilia. Would he be willing to look over the contents of the old building and suggest what might still have commercial value, what might be of historical interest and what was fit only for the tip?

A preliminary inspection, he said, revealed an enormous collection of what had once been new components. But unfortunately, the building had been penetrated by vandals and a lot of cartons had been ripped open for no apparent reason. Filing cabinets had been stolen — after their contents had been emptied onto the floor. Even more seriously, the vandals had gained access to the roof and ripped away a lot of the lead flashing, allowing rain-water to seep in.

He nevertheless made an appointment to meet a trustee on the premises on a particular date, on the understanding that they would preserve what he recommended, leaving it to the renovators to clear out the remainder so that they could get on with their restoration work.

Kevin said that, due to a last-minute hitch, he was not able to keep the appointment. By the time he arrived on the scene, the renovators had largely cleared the building on their own account, by the

simple expedient of opening the windows and hurling everything on to the concrete below — and out into the rain — ready for the bulldozers to load it on to dumptrucks, along with refuse from the overgrown grounds.

All Kevin could do was rescue what had miraculously survived the mass destruction and offer it to Sydney's Powerhouse Museum, along with a few pictures and documents that had also escaped. What use they make of it over the years will no doubt be dictated by the bugbear of all Australian museums: the funds needed to sort, catalog and display what is made available to them.

Such then is the somewhat fragmented story of the Royal Navy 'wireless boy' who will be remembered by his industry peers as 'Cap' Slade of 'Calstan'; and by me as the man who produced the first decent meter that I ever owned!

Wireless publications

As mentioned earlier, some of the foregoing information was supplied by Colin MacKinnon, VK2DYM — not VK2DYN, as indicated in the April 1992 issue. In that same issue I remarked that 'a startling number of radio periodicals had been launched in Australia over the years, only to pass into limbo'.

Seeking to quantify that number, Colin MacKinnon appended to his letter a printout of a listing he once compiled of Australian radio periodicals, and directly related books that he had been able to identify up to the relevant time.

Being in the form of an index, it includes all the titles under which various publications have been known, so that this journal, for example, has been listed separately in all its variations from *Radio and Hobbies in Australia* to *Electronics Australia with ETI*. Even so, Colin's listing is nearly three pages long and, at a quick count, adds up to over 120 titles.

Without pausing to examine each and every one, I recognised a lot of them; others, I would not have seen, because their circulation was confined to other states. Our own offshoot *Videomag* from the early 1980's does not appear, nor did I notice many of our spin-off publications like *Basic Radio Course*, the *EA Log Book* or the *Hifi-Stereo Annual*.

Perhaps the simplest course is to agree that, however defined, the number of Australian radio-related periodicals was/is indeed 'startling'.

Mentioned in Colin MacKinnon's list is the *NSW Wireless News*, which I had not heard of before. At just the right time and by happy chance, a reader from Woden in the ACT who prefers to

be recognised only by his initials 'P.J.W.' had come across a couple of issues of this very magazine, and posted to me colour photostats of the covers and of typical advertisements. Dated August 15, 1925 and October 3, 1925, the magazines are of normal bookstall ('quarto') size, with colour covers and provision inside for colour advertisements. The cover price is twopence!

Curiously, both covers use the same colour graphic, the only difference being in the date and volume number and the nature of the inset advertisement. The advertiser in each case is P.H. Clark Ltd, of 38-44 Carrington St, Sydney — of whom I have never heard before. The October advert features 'Tower's Scientific' headphones for 19/6d, while the August issue offers a Lincoln folding loop aerial for Superhet and Tropadyne receivers.

Which prompts me to ask: what on earth was a Tropadyne receiver? ❖

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In a country the size of Japan, space is regarded as life's ultimate luxury. Which is why a Pioneer Contempo System takes up so little. 🌀 It's around one-third the size of a conventional sound system, so the only time it will dominate a room is when you turn it on. 🌀 Of course, you'd expect the list of features to have shrunk along with the

dimensions. Instead it's grown. 🌀 There's a programmable multi-CD player with random play (so even your favourite CDs won't get boring), automatic tuner, twin tape deck, timer, powerful 3-way speakers, even a full function remote control. And that's before Pioneer started getting clever. 🌀 The 'vocal cancel' button cuts out the lead singer

so that you can sing along with your favourite tracks. 'Smart operation' memorises all your favourite settings, so you don't have to. 🌀 There's even a control that will make your room sound bigger. (How very Japanese.) 🌀 Which proves you no longer have to give up your space for your music. Whether you live in a Balmain flat, or a Tokyo machiya.



Fill your room with sound, not the sound system.

As it happens, the landscape moves by the industry, the landscape that is now available is predominantly NTSC format, with an emphasis on a specific genre of films like Terminator II and Hunt for Red October. Luckily, these movies in- corporate superior Dolby Surround sound, which conventional videotapes are simply unable to emulate. However, in order to use the full potential of such software as well as a hi-fi stereo system, you also need a compatible multi-channel audio system with the sophisticated decoders

The remote control for the PTV system has no many buttons as you'd think to find on a movie player. It's compact

well aware of space to which video film output have increased in number of recent years. However, this more evident than on the east coast of Australia, where I have come to the conclusion that more than ever the public is taking notice and escaping from its problems by way of watching video.

Of course, it's possible that I may have missed the other relevant ones — the two continual improvements in the quality of pre-recorded video, or the availability of an unrivaled range of new software, which undoubtedly "fills" the fancy of avid and frequent users. As it isn't worth enough, the

PIONEER
The Art of Entertainment

KENWOOD'S NEW FV7 'FORVISM' SYSTEM



This month, Louis Challis reports on an extended period spent both measuring and trying out the new Kenwood FV7 — a very compact but surprisingly capable home audio-visual entertainment system. Features include 240W of power amps, spread over six channels, and full Dolby Pro Logic digital surround sound capabilities — which really enhances laserdisc movies.

I should imagine that most readers are well aware of the extent to which video hire outlets have increased in numbers of recent years. Nowhere is this more evident than on the east coast of Australia, where I have come to the conclusion that more than ever the public is taking solace and escaping from its problems by way of watching videos.

Of course, it's possible that I may have missed the other relevant clues, — like the continual improvements in the quality of pre-recorded videos, or the availability of an unrivalled range of new software, which undoubtedly 'tickles the fancy' of avid and frequent users. As if that wasn't enough, the last year has seen yet other changes — like the slow trickle of video laserdiscs into



The remote control for the FV7 system has as many buttons as you'd wish to find. No more please, Mr Kenwood!

selected outlets, which is much appreciated by the long suffering purchasers of laserdisc players, who either had to import their own software, or were forced to use their combi players to play only CD's.

As it happens (and despite belated moves by the industry), the laserdisc software that is now available is predominantly NTSC format, with an emphasis on a specific genre of films like *Terminator II* and *Hunt for Red October*. Happily these movies incorporate superlative Dolby Surround Sound, which conventional videotapes are simply unable to emulate. However, in order to use the full potential of such software, as well as a laserdisc player you also need a compatible multi-channel audio system with the appropriate decoders

to complement the laserdisc system and then — wow! — your single channel mono (or even your two channel stereo) system suddenly takes on a whole new dimension. You transcend your monophonic world and jump into a new audio environment that I would best describe as 'hypersound'.

Five years ago, Yamaha Corporation was the initial leader in this field, but others were quick to follow and there are numerous new players with new products which fulfil the demanding requirements imposed on them by the licensees. One of the most significant is the Kenwood Corporation, which has gone more than one step further than most of its competitors with its new FV7 Laser Disc Component System.

As I soon discovered, this system appears to be something of a 'wolf dressed up in sheep's clothing'. Although the FV7 incorporates an unrivalled degree of technical complexity, it has been carefully configured so that novices and other technically naive users can operate the system with minimal understanding of its unusual range of functional characteristics.

The FV7 has two main electronic modules, which are designed to be stacked one on top of the other. The lower module is an LVD-V7 laserdisc player, which will play six different types of CD, CDV and (NTSC) laserdiscs, whose sizes may range from a 12cm diameter CD single, all the way through to 30cm (NTSC) laserdiscs. The LVD-V7 incorporates numerous secondary control circuits, by means of which the switching and operating circuitry may be directly controlled by the RX-V7.

Many features

In keeping with the latest US trend, the RX-V7 incorporates six audio amplifiers (two front, two rear and two for presence), and it also provides a seventh 'line' output for a self-powered separate subwoofer. Each of the amplifier channels is controlled by the digital sound processing (DSP) circuits, and in particular by the digital Dolby Pro-Logic decoder which has been configured so that each speaker may fulfil a wide range of functional surround sound requirements. The most attractive feature of the system is that it has been pre-programmed to provide virtually optimum settings without readjustment.

With front channel amplifier peak power output capabilities of twice 60 watts, backed by a further 30W per channel for the rear and presence channels, the RX-V7 receiver/cassette player has the capability to really 'enliven' your living room's audio potential. With a peak output capability of more than 240 watts plus whatever may be contributed by the separate subwoofer, almost any living room can duplicate sound levels and a level of audible reality which you would only have previously ex-



A close up of the centre and right-hand section of the front panel on the RX-V7 receiver. There are a relatively large number of control buttons, but many of these are only used occasionally.

perienced in a large and well-equipped cinema.

Naturally, the audio quality and its output levels are dependent on the type of speakers that are connected to the system's output terminals. In the case of the FV7 system, it incorporates a pair of unusual dedicated S-V7 speakers, which are designed to satisfy the dual functions of the main frontal speakers (using pairs of dedicated three way speakers) as well as incorporating a separate 100mm diameter driver in each enclosure for the two presence channels. The S-V7 enclosures are cunningly configured so that the main speaker's radiation axis points to the front in the normal way, whilst the presence speakers are neatly angled to satisfy the oblique sound radiation requirements and thereby fulfil their presence role.

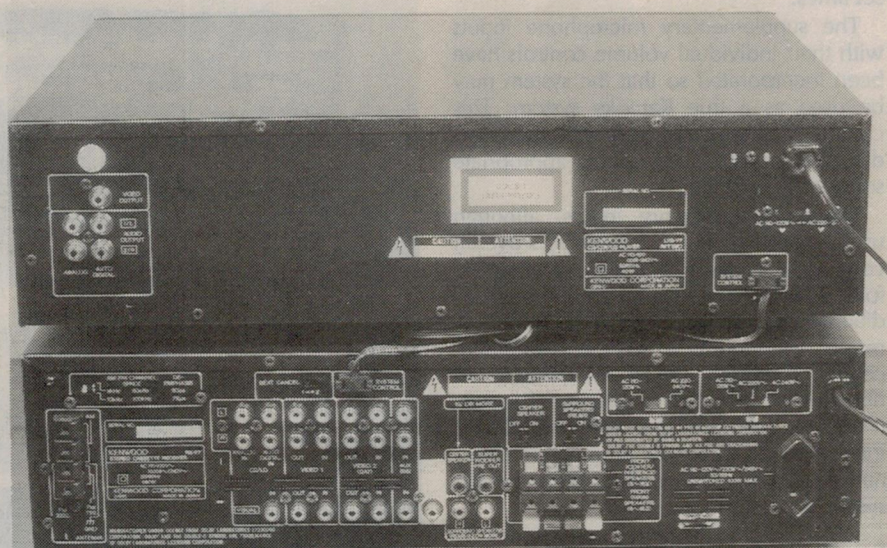
The rear speakers generally only need to fulfil a somewhat less demanding role, and consequently relatively small speakers which only need to cover a somewhat more limited frequency range may be used

in this role. Kenwood supplied us with a pair of CM-01 speakers, which although relatively small, were quite adequate for the purpose — as well as providing us with a separate model CS-6 self-powered centre speaker which was purpose designed for this role.

To ensure that we had true 'theatre sound' for our subjective evaluations, they also provided us with a model SW-700 self-powered 'superwoofer' which neatly covers the 20 to 150Hz bandwidth. So when the guns fired and the bombs exploded, we almost had no option but to duck and wince in response to the realistic signals.

When all the components of the FV7 system are interconnected to provide eight channels of sound amplification, there are a myriad of wires draped around the room, and the appearance can be far from tidy. Obviously, in a more permanent setup these wires would pose less of a problem, as they could be neatly hidden.

A potentially more significant issue for



A rear view of the LVD-V7 laserdisc player (top) and the RX-V7 receiver, showing the connectors. Note that a special 'system control' cable is used to interconnect the two, so that the receiver can control some of the player functions.

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many people may prove to be firstly *how*, and subsequently *where*, the speakers might be placed to satisfy the aesthetic and political issues, which would undoubtedly erupt in some situations to face the 'culprit'.

Most people experience some problems when they need to add a second pair of speakers to their living room. The problem becomes far more complex when six separate speaker modules need to be permanently added to a living room — unless of course the room is dedicated to that purpose, as typified in the American 'Home Theatre' concept. But few Australians are able to dedicate a room for such purposes, and what potentially started out to be an advantage could well become a liability.

The RX-V7 receiver also incorporates a standard compact cassette player, which is capable of directly recording sound tracks from CD's or the FM/AM stereo tuner, as well as from the two Karaoke microphone inputs with which the receiver is equipped. The cassette player provides auto-reverse recording, and Dolby HX-Pro, Dolby B and C noise reduction systems. More significantly it also contains 'CCRS' (computer controlled CD recording system), which provides automatic one-touch recording from a CD without the need to adjust the recording levels and with fully automated recording that takes the guesswork and the heartache out of the task. The ability to provide automatic 'fade in' and 'fade out' at the beginning and end of a tape, as well as between individual songs or items on a tape, is also provided at a touch of a button.

The RX-V7 also incorporates a digital clock, which uses the central display and which is designed both for simple setting and for starting the complete system at pre-set times.

The supplementary microphone inputs with their individual volume controls have been incorporated so that the system may be used as a true Karaoke system. This capability neatly integrates with the laser-disc player, particularly where appropriate software is available.

These supplementary inputs, although undoubtedly adding to the system's overall complexity, make it much more attractive for the serious home/video user and the additional capabilities ensure that the system may be used as a true 'home entertainment centre'. Although the RX-V7 contains an unusually large range of functional inputs, it has also been provided with the ability to interconnect an even larger range of external systems (including other hifi or video systems).

Front panel controls

The functional controls on the front panel have been intelligently simplified so that the number of control functions and the

amount of printed labelling appears to be surprisingly low. It is only after you read the instructions, or pick up the sophisticated remote control, that you discover that what you have been examining is only the 'tip of the iceberg', and there are an absolute plethora of secondary control functions and optional settings, which are only activated by operating two or more switches and/or buttons in sequence, to access those optional controls.

The controls and functions on the receiver's front panel are divided into four groups with the cassette player and its controls on the left-hand side of the front panel, whilst the MASTER VOLUME control and INPUT/PRESENCE controls with the microphone inputs are on the right-hand side. In the upper central section of the panel the multi function display provides comprehensive data on nearly all of the major functional capabilities. These are illuminated when a specific function is activated, so that for example when the tape recorder is switched on, all the relevant data is provided on the tape transport, its direction and on the activation of Dolby noise reduction system being used for record or replay.

The FM/AM tuner functions are similarly indicated in terms of STEREO, whether the selected frequency is correctly TUNED, whether the frequency is in MEMORY, or whether the tuning is in the AUTO mode.

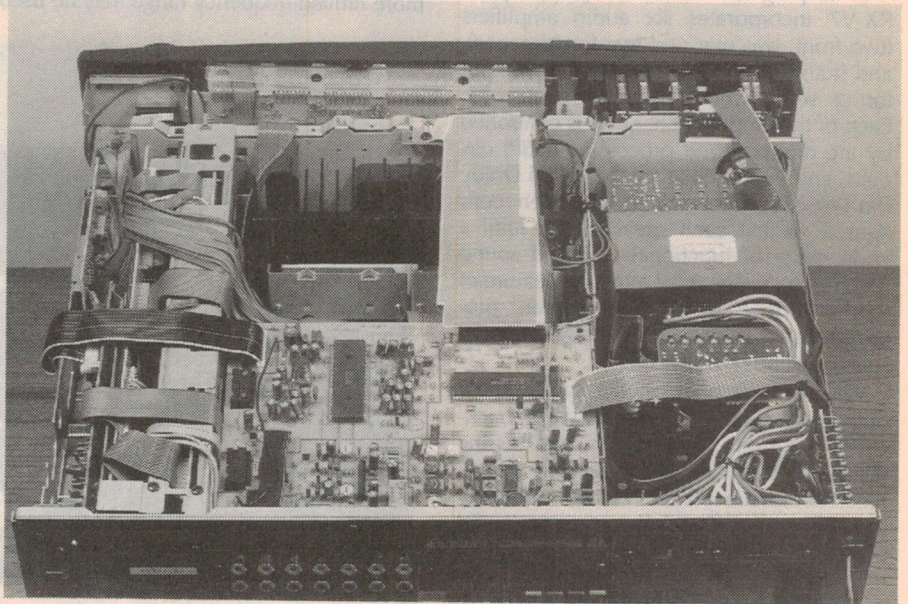
There are similar displays for the timer clock, to confirm whether the VCR or LASER DISC has been selected or to confirm that the KARAOKE or other related systems have been activated. In the lower section of the display are a series of nine multi-element plasma displays which pro-

vide alphanumeric data in terms of the selected frequencies, times, chosen inputs or the input which has been separately selected through the rotation of the input presence control.

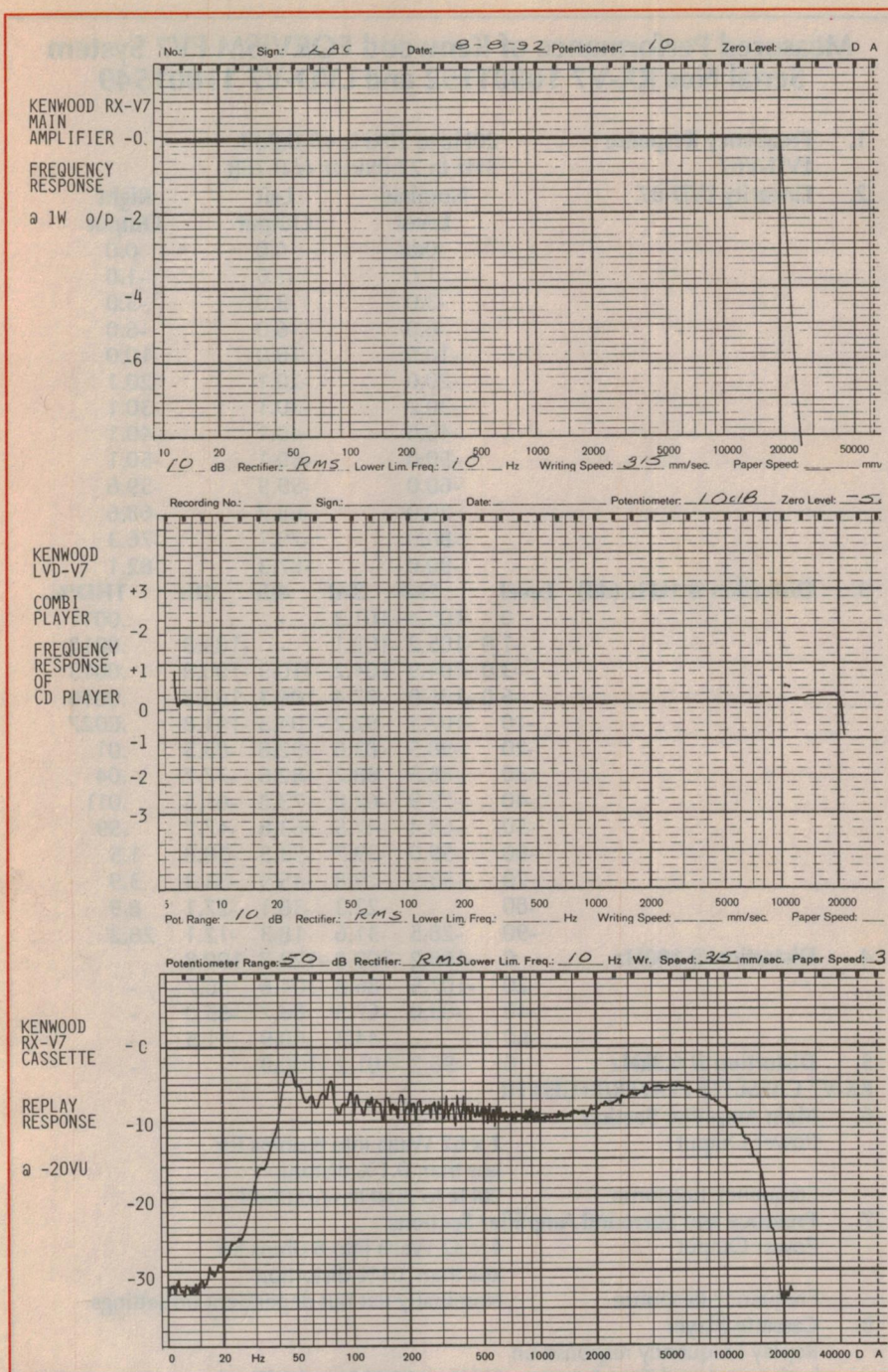
In the lower central section of the front panel there are two rows of switches through which you may select infrequently required functions. These are labelled DOLBY PRO LOGIC, PLAY MUSIC, PLAY MOVIE, PLAY GAME, PLAY SINGLE, AUDIO TRACK, ECHO LEVEL, 'KEY CONTROL UP/DOWN' keys (for varying the replay pitch of CD's and CDV's) and an NB (Natural Bass) key, through which a range of bass equalisation characteristics may be selected.

To the right of these controls are the TIMER CLOCK, BAND, TUNER MODE and ENTER keys, whilst in the lower central section are the FAST, FORWARD and REWIND keys for the cassette player, and the other cassette player controls including a RECORDING/ARM key (which is a variant of the conventional recording button), together with FADE MODE and DIRECTIONAL CONTROL keys. All of these controls, are of course matched by similar buttons on the multi-function remote control, which provides unrivalled flexibility.

The rear of the receiver has an array of aerial sockets for the FM/AM tuner on one side of the rear panel. In the middle there are four neatly grouped arrays of audio input and output sockets, with associated video sockets immediately below. These are provided for the CD/laserdisc input for Video 1, for Video 2 (or DAT recorder) and for an auxiliary input. In the centre of the rear panel there are four RCA co-axial



A general view inside the RX-V7 receiver. As you can see, there is very little space to spare. The main power amplifier modules and their finned heatsinks are visible in the centre of this view, surrounded by a large number of PCB assemblies.



Three representative frequency plots for the Kenwood FV7 system. At top is the response of the main receiver amplifier; in the centre is the response of the disc player; while at bottom is that for the RX-V7 cassette player.

audio output sockets serving the centre speaker (for which no supplementary amplifier is required), the two surround speakers for which no supplementary amplifiers are required, and the subwoofer line output, which requires its own amplifier.

To the right of these sockets are four pair of sockets for the main and presence speakers, which are neatly colour coded to match the colour coding on the cables provided. These are flanked by switches for the centre and surround speakers, which

may be de-activated, when they are not required.

A further socket is provided for the special system control cord, through which the LVD-V7 laserdisc player's functions may be controlled by the RX-V7.

On the instruments

The objective and subjective evaluations of a multi-functional system as complex as the Kenwood FV-7 could have involved me in more than three days of laboratory testing, and consequently I decided to assess

the primary performance parameters, rather than all parameters, and then subject the system to the potentially more demanding subjective assessment with appropriately selected software.

The obvious starting point for my evaluation was to assess the performance of LVD-V7 laserdisc player, using conventional CD test software, and then with some well chosen video test software. As I might have expected, the majority of the LVD-V7s objective performance parameters were excellent. The frequency response in the CD player mode was ruler flat from 5Hz to 9kHz, and it recorded a commendable overall frequency response of 5Hz to 22kHz ± 0.2 dB. The conversion linearity of the digital to analog converters was good all the way down to -60dB, but thereafter they exhibited conversion non-linearities which were typical of their class, and not outstanding.

The distortion characteristics of the CD player circuitry were similarly good down to -60dB, but thereafter the distortion characteristics increased rapidly, in precisely the same way that it affects virtually all other 16 bit D-A converters. The other conventional parameters like rotational frequency accuracy of the CD player motor and de-emphasis characteristics were also exemplary.

I evaluated the performance of the laserdisc player using Reference Recordings' video standard disc (LD-101), and was impressed by the frequency bandwidth of the laserdisc section — which appears to extend out to at least 3.5MHz. I followed this up with some Sony CDV software that I purchased in Japan, and was pleasantly surprised by the quality of the video signal, which was nearer to what I would have expected from a PAL signal than an NTSC signal.

I progressed to the objective testing of the RX-V7 cassette/receiver, and was not surprised to find that the main output amplifiers produce a genuine 62 watts per channel into 8Ω loads, plus four channels of 32W each into 8Ω loads when all six channels are being driven simultaneously. As I would have expected the amplifiers become rather warm under these conditions, but this would probably not happen during normal operation — even for an extended period.

The frequency response of the main channels is extremely smooth, and being within 0.1dB from 10Hz to 20kHz. The frequency response of the other channels is a little more difficult to evaluate, but they proved to be nearly as linear and flat when the regular play mode with 'soft' response is selected. The distortion characteristics of the main amplifier channels are extremely low, and with peak power outputs of up to 55 watts the total harmonic distortion is less than 0.03%.

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As the power output of the main amplifier channels each approaches the 60W level, the THD starts to rise, and at 62 watts output into 8Ω, is already up to 0.1%. Incremental changes of the input signal as small as 0.1dB produced startling increases in the total level of distortion, once the 62 watt output power level is reached. In other words, the onset of clipping is quite sudden.

The compact cassette player achieves a reasonably wide frequency response, and although it extends from 38Hz to 12.5kHz on replay (using a standard replay test tape), it's not as flat as I might have expected or desired. Although the frequency response is acceptable, the wow and flutter level certainly leaves something to be desired. In fact the response perturbations caused by the wow are quite audible, and are clearly visible on the replay frequency response graph. The frequency response itself appears to have been deliberately peaked in the 2kHz to 10kHz region to provide a slightly wider replay bandwidth.

On record, the frequency response is marginally better, although the wow and flutter figures remain basically unchanged.

The FM stereo tuner's performance is quite good, with a useable sensitivity of 0.8 microvolts and a frequency bandwidth which is better than 16kHz at the -3dB point. The signal to noise ratio is extremely good, and the performance of the FM tuner is substantially better than I would have expected. By contrast the AM tuner's performance is little better than most portable transistor radios, and in this respect is sadly typical of its class.

Listening tests

The subjective evaluation of the FV7 system was spread out over a period of two months, during which I viewed a number of pre-recorded laserdiscs — including segments from *Terminator II*, which although incorporating a fantastic audio sound track, is just not my kind of video.

By contrast, the *Hunt for Red October* had my family and I glued to our respective seats, whilst they were able to stay. The quality of the sound and the quality of the picture were superlative, and the Dolby Surround provided a level of audible realism which was superior to that which I had experienced in any cinema. It was extremely commendable.

I listened to a wide range of pre-recorded CD material, including two new discs from Sony which were carefully selected to assess the audible quality of the system. The first of these discs was Kathleen Battle and Wynton Marsalis in *Baroque Duet* (Sony Classical SK 46672). As I soon discovered, with eight speaker systems connected and with conventional two-channel stereo

Measured Performance of Kenwood FORVISM FV7 System Serial Nos RX-V7 10901152 and LVD-V7 11001549

1.	Frequency Response	20Hz to 20kHz +/- 0.2dB					
	LVD-V67	5Hz to 22.05kHz +/-0.2dB					
2.	Linearity LVD-07	Nominal	Left		Right		
		Level	Output		Output		
		0dB	0.0		0.0		
		-1.0	-1.0		-1.0		
		-3.0	-3.0		-3.0		
		-6.0	-6.0		-6.0		
		-10.0	-10.0		-10.0		
		-20.0	-20.1		-20.1		
		-30.0	-30.1		-30.1		
		-40.0	-40.1		-40.1		
		-50.0	-50.1		-50.1		
		-60.0	-59.9		-59.6		
		-70.0	-68.7		-68.6		
		-80.0	-79.1		-76.3		
		-90.0	-87.3		-82.1		
3.	Distortion @ 1kHz (dB)	Level	2nd	3rd	4th	5th	THD%
		0	-105.4	-101.3	-	-	.001
		-1.0	-105.2	-102.1	-	-103.8	.0012
		-3.0	-104.9	-104.2	-110.9	-100.8	.0013
		-6.0	-106.9	-97.4	-106.3	-103.8	.0016
		-10	-107.1	-92.2	-104.3	-101.8	.0027
		-20	-98.5	-83.0	-92.8	-83.5	.01
		-30	-88.5	-68.2	-82.6	-77.7	.04
		-40	-79.9	-62.8	-73.8	-61.5	.011
		-50	-68.4	-47.5	-63.8	-47.7	.59
		-60	-59.0	-39.7	-53.5	-38.8	1.5
		-70	-53.9	-29.8	-45.9	-33.3	3.9
		-80	-	-22.3	-38.1	-27.1	8.9
		-90	-28.5	-31.6	-18.3	-12.1	28.2
4.	Distortion @ 100Hz	0	-108.2	-103.8	-122.7	-100.8	-
		-20	-107.5	-86.8	-104.8	-86.7	-
		-40	-89.0	-67.9	-88.7	-65.0	-
		-60	-	-44.9	-60.9	-41.5	-
5.	Distortion @ 6.3kHz	0	-98.2	-101.2	-100.9	-	-
RX-V7 CASSETTE PLAYER/RECEIVER							
6.	Main Amplifier Section						
	Power Output	2 x 62 Watts into 8 ohms for less than 0.1% distortion					
	Frequency Response	20Hz to 20kHz +/-0.05dB					
7.	Presence and Surround Amplifier Sections						
	Power Output	4 x 32 Watts into 8 ohms for less than .01% distortion					
	Frequency Response	Nominally flat but dependent on settings					
8.	Cassette Player						
	Replay Frequency response on both type 1 and Type 2 tapes	37Hz to 12.5kHz +/-3dB					
9.	FM Stereo Tuner						
	Sensitivity	0.8 microvolts					
	Frequency Bandwidth	20Hz to 16.5kHz +/-0 -3dB					

material, an inappropriate DSP program can convert a beautiful piece of music and a wonderful singer or musician into a muddy and almost distorted result. Of the available options, I found the best to be the 'regular' setting, and for the softmode — otherwise the results were disturbing and discordant to my ears.

The second disc which I used was John Williams' *Iberia* (Sony Classical SK-48480), which also provided an invaluable insight into the audible characteristics of the FV7

system.

Whilst Dolby Surround sound and the range of the DSP functions available within the system may offer the user with a wide range of acoustical environments, in the end I found the regular mode to be the best, and when listening to classical guitar music of this type, I found it best to switch off the surround speakers and the subwoofer where there was no obvious need or input to justify their use.

Continued on page 98



We've recently taken on a new line in soldering irons - Hakko - and they are excellent value for money offering features usually costing much more. We have the full range available, but check out the 926 adjustable temperature iron, the memory card 927 and dual station 928. If you're thinking about buying or upgrading your soldering equipment call in and discuss your requirements.

Hakko 926 Soldering Station

The Hakko 926 (above) is a super-quick heat-up (3 sec cycle) and fast recovery iron offering high quality soldering at lower tip temperatures. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V. Also available in ESD for antistatic environments. We stock a wide range of tips to suit. Ask for listing.

Hakko 927 Soldering Station

Incredible memory card iron. Just look at the features -

- Digital adjustment/display system using built-in microcomputer.
- Convenient memory cards for quick and simple tip temperature adjustment and monitoring.
- Accurate Temperature Adjustment and Monitoring - Simply insert the card, set the desired temperature and push the set ("S") button. Once the temperature is set, it cannot be changed without re-inserting the card.
- Temperature Memory System - The tip temperature value is stored in the memory of the built-in computer allowing you to turn the power off and on without having to reset the temperature each time.

The HAKKO 927 ESD Soldering Station is available for static safety and meets MIL-STD-2000

Solder

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153	Cutting/Forming for Axial Components	\$1148.00	\$1312.00
154	As 153 but for Axial Components 5mm	\$1198.00	\$1369.20
155	Cutting for Radial Components	\$1324.80	\$1508.80
156	Parts Feeder for 153 and 154	POA	POA
191	Thermometer with Large Digital Display	\$250.00	\$278.80
191-211	191 Sensors per Pack of 10	\$17.25	\$19.65
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483.1	Complete Desoldering Gun	\$415.70	\$473.85
485	Solder/Desolder Station with Solder Bath	POA	POA
493	Smoke Absorber	\$195.75	\$233.15
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745	Battery Powered Iron 7.2V Operation	\$160.00	\$182.40
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851	SMD Station	\$650.00	\$741.00
883	Hot Air Gun-1000W, 1250m ³ /min	\$194.40	\$221.40
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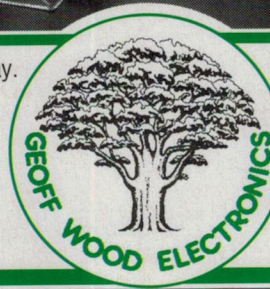
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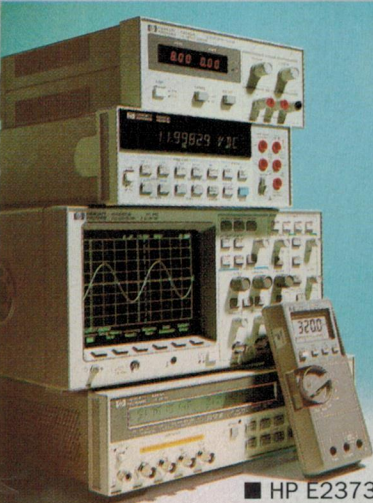
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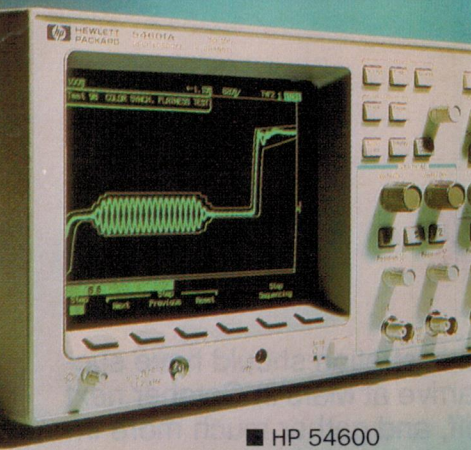
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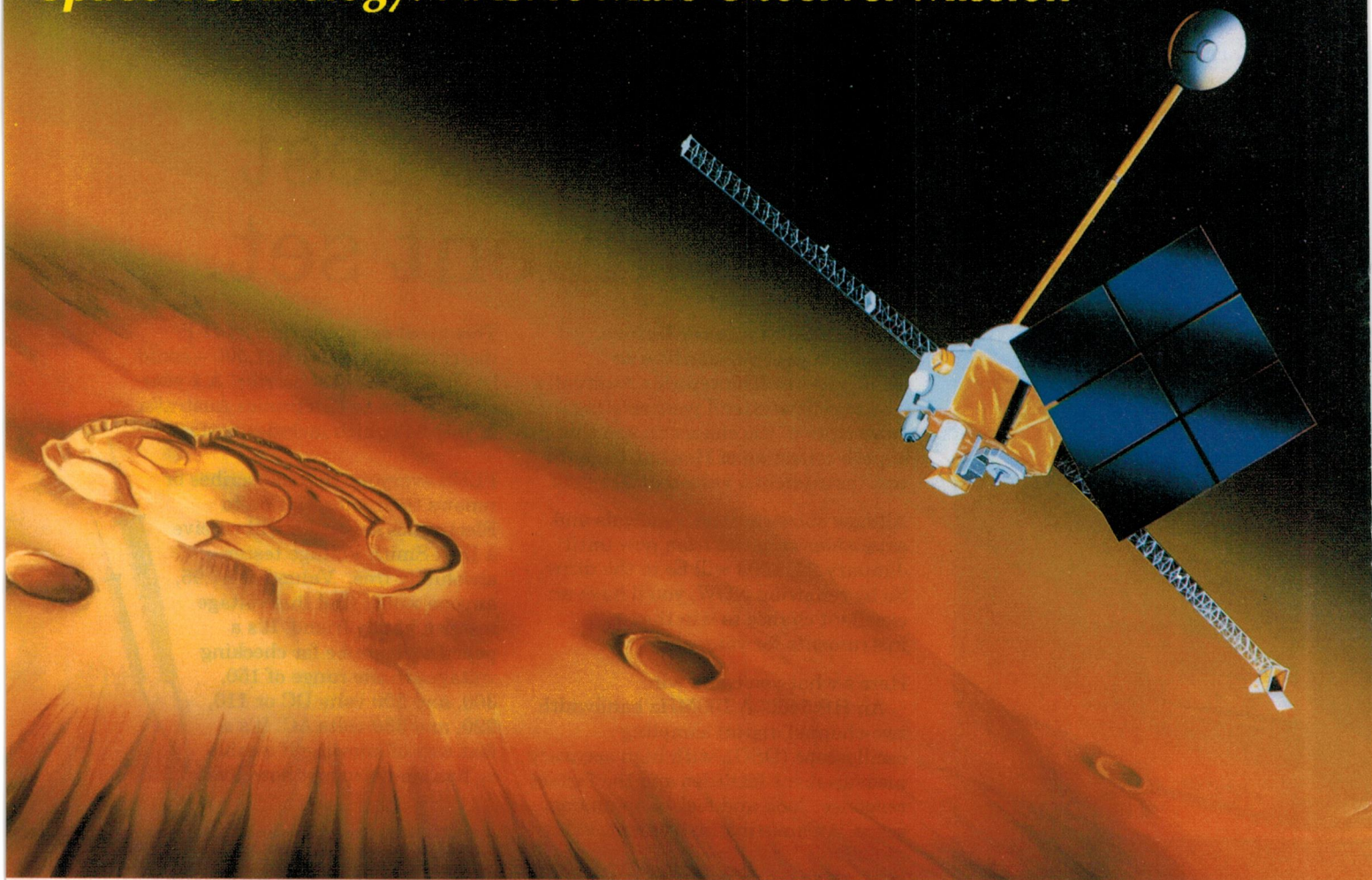
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BACK TO MARS, FOR A CLOSER LOOK

By the time you read this, the US National Aeronautics and Space Administration should have successfully launched its long-planned Mars Observer spacecraft. Due to arrive at Mars in October next year, Observer is designed to take up where the Viking missions left off, and gather much more information on the red planet — our nearest neighbour in the solar system.

by KATE DOOLAN

This year is International Space Year, and one of the most awaited highlights has been planned to take place in September. For the first time in 17 years, the United States is preparing to launch a robot spacecraft to the planet Mars, with a plan for humans to follow in the next 25 - 30 years.

The *Mars Observer* spacecraft will be following in the steps of the highly successful Viking spacecraft of the late 1970's, to help

scientists get a better understanding of the planet that is nearest to Earth in physical description and has been touted as 'replacement planet' for Earth in the next 200 years.

Because of its proximity to Earth, Mars has been a favourite destination for robot spacecraft from the United States and the former Soviet Union for the last 30 years. The first successful flyby of the planet was made by the American *Mariner 4* spacecraft

in 1965. In 1976, two *Viking* spacecraft which comprised an orbiting stage and a surface lander arrived at Mars, and for the next six years sent data back to Earth. The main finding of this flight was that Mars did not have any life forms on it at that time, or in the recent past.

The former Soviet Union did not have much success in sending spacecraft to Mars. They made a first attempt in 1960, but the

rocket blew up on the launch pad — much to the chagrin of then premier Nikita Khrushchev, who had hoped to make propaganda points during a visit to America.

Attempts were made through the sixties and seventies to send spacecraft to Mars, but these attempts were also unsuccessful. It was said that the Soviet's efforts were hampered by the 'Great Galactic Ghoul', a mysterious being that gobbled up Soviet Martian spacecraft!

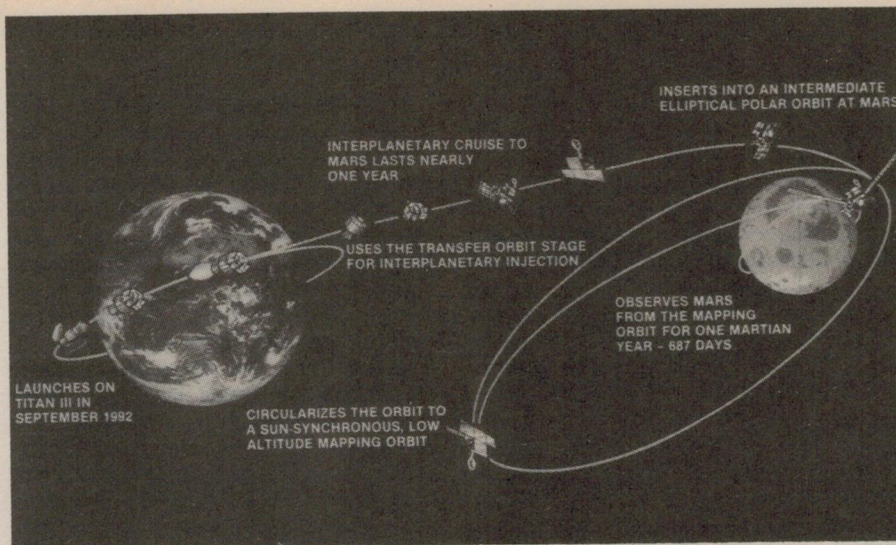
The latest Soviet attempts were the launches of the Phobos probes in 1988. The first spacecraft failed during its journey to Mars, but the second one arrived at Mars, sent some data and images back then mysteriously stopped transmitting. The problem was found to be a radio breakdown as the spacecraft was approaching the Martian moon Phobos.

Mars is the fourth planet from the Sun at a distance of 227 million kilometres, and takes 687 days to complete one orbit of the Sun. Mars is named after the Roman God of war and has two moons, Phobos and Deimos, which were discovered by American astronomer Asaph Hall in 1877. The Martian atmosphere consists of 95% carbon dioxide, and surface temperatures range from minus 14°C in summer to minus 120°C in winter.

The surface of Mars is a bleak, rocky, red landscape with large dried up river beds. Large canyons and mountains are a prominent feature of the planet — one extinct volcano, Olympus Mons' base would stretch the distance from Ballarat to Canberra and is 28,000 metres high, more than three times the height of Mount Everest.

Like Earth, Mars has polar ice caps at the top and bottom of the planet and they contract and shrink during the Martian winter and summer.

The *Mars Observer* spacecraft was



A graphical outline of the overall flight path trajectory for Mars Observer, showing also the times and durations of each phase.

originally conceived during the early 1980's, when the US National Aeronautics and Space Administration (NASA) established a Solar System Exploration Committee at its headquarters in Washington DC, to determine what direction solar system exploration should take for the eighties and nineties.

One of the suggestions was for an orbiting Mars spacecraft to be launched in the late eighties. Originally known as the Mars Geoscience/Climatology Orbiter, responsibility for the renamed *Mars Observer* project was handed to the Jet Propulsion Laboratory (JPL) in Pasadena, California, after approval to build the spacecraft was granted in fiscal year 1985.

Originally scheduled to be launched from the space shuttle in 1990, the date was changed to 1992 after the *Challenger* exploded in 1986. It was also decided to

launch the *Mars Observer* aboard a Titan III expendable launch vehicle.

The *Mars Observer* design is based on those of RCA communications and defence mapping satellites, but has been modified for this flight. Weighing 2487 kilograms, the spacecraft consists of two main parts: the spacecraft itself, known as the 'bus' and the science instruments called the 'payload'.

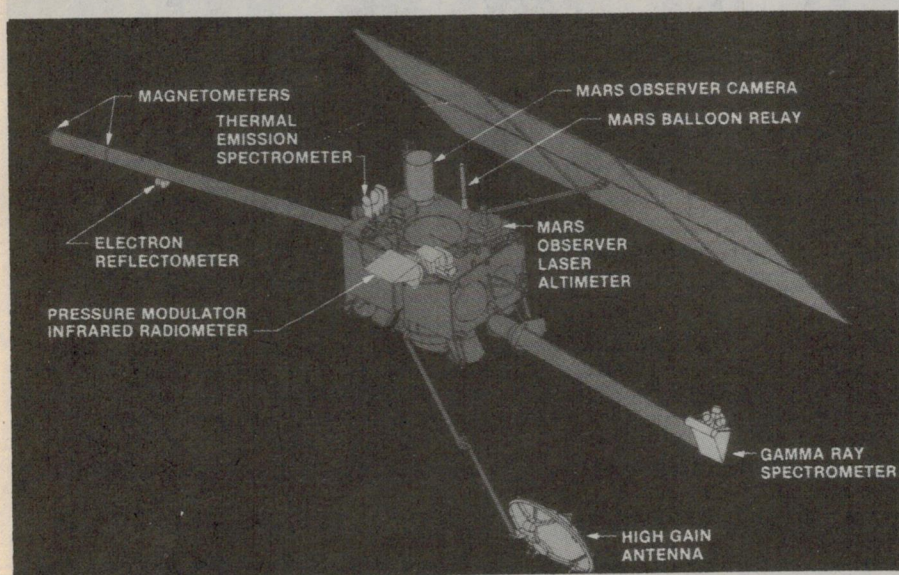
When the spacecraft is launched, the antenna, instrument booms and solar arrays are folded close to the bus — which has a box shape and is three metres high, three metres wide and three metres deep.

Instrument payload

There are seven scientific instruments on the *Mars Observer* spacecraft. These instruments will be used to provide a more detailed look at Mars than the *Viking* spacecraft, and give scientists information that can be used for an eventual human journey to the red planet.

The Gamma Ray Spectrometer (GRS) is mounted on a boom of the spacecraft and has a high spectral resolution germanium detector cooled to minus 560°C. The GRS will measure the intensities of characteristic gamma ray lines that emerge from the Martian surface, within the energy range of 0.2 to 10 million electron volts. A boron doped plastic scintillator will serve as a charged particle shield and neutron detector to determine the abundance of hydrogen. The key objectives of this experiment are to determine the elements present on the Martian surface to a resolution of a few hundred kilometres, through measurements of gamma rays originating at the surface.

The Thermal Emission Spectrometer (TES) is a Michelson interferometer, which uses thermal infrared measurements to determine surface temperatures and mineral composition of the Martian surface. The objectives of this investigation are to evaluate the composition of surface minerals, rocks and ice to



The overall configuration of the 'Mars Observer', when it is orbiting Mars late next year. The function each of the identified facilities is explained in the text.

Back to Mars, for a Closer Look

map their distribution, and study the growth, retreat and energy balance of the Martian polar caps. Other investigations for the TES include measurement of the thermophysical properties of the surface, which can be used to derive surface particle size, rock abundance, surface temperature, water vapour and ozone profiles.

The Mars Observer Laser Altimeter (MOLA), is a diode-pumped laser transmitter and a 500mm diameter parabolic receiver, which produces 100m-diameter footprints with 2m vertical precision at 10 pulses per second. This will be the debut of a diode-pumped laser altimeter on a planetary mission. The key goals of the MOLA are to establish a global topographic grid with a vertical precision of 30m to address problems in geology, geophysics, atmospheric circulation and to measure globally distributed topographic profiles, which will identify local and regional geological and geophysical problems.

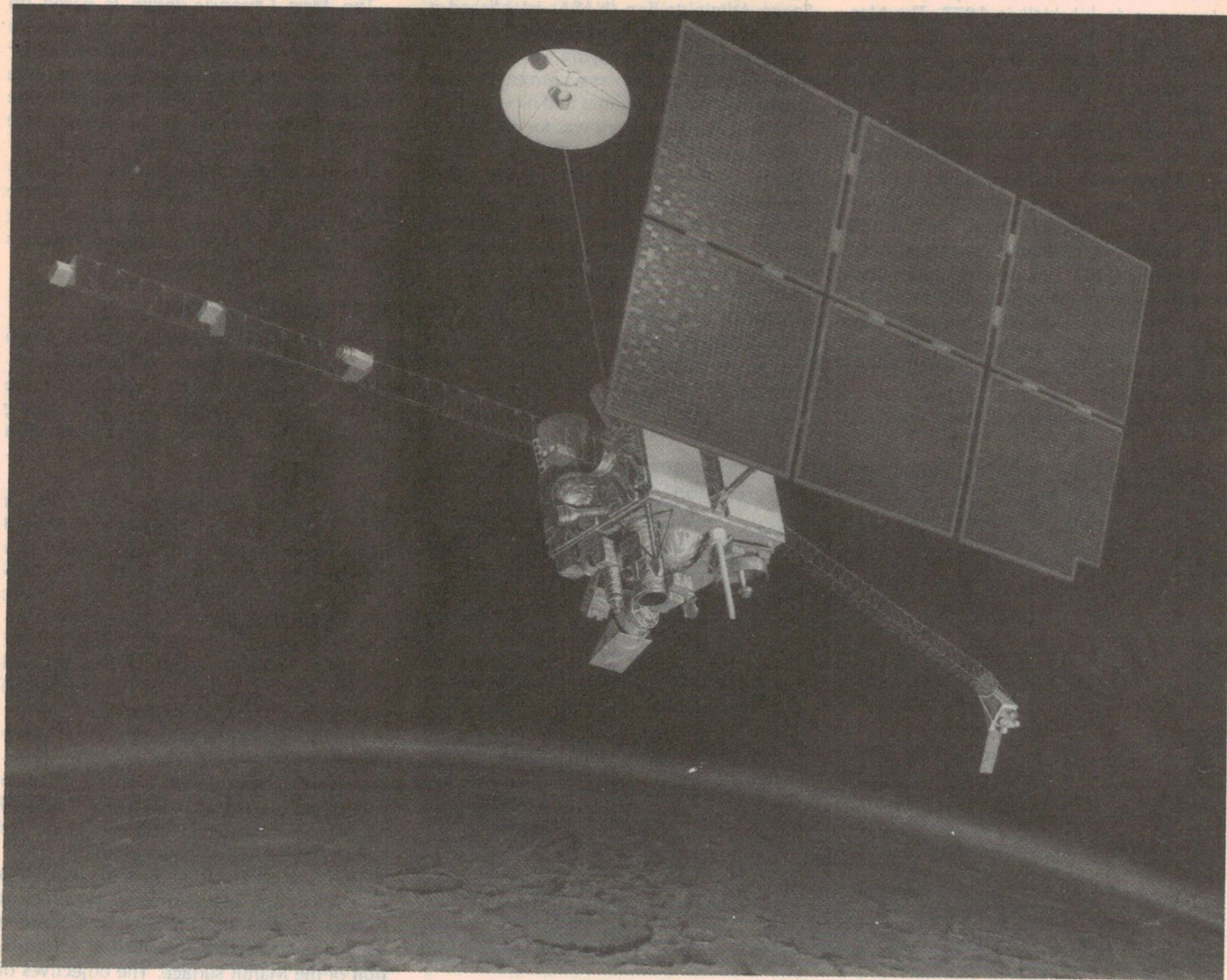
The Radio Science (RS) experiment will be using NASA's spacecraft radio and tracking stations of the Deep Space Network (DSN) to serve as the scientific instrument for this investigation, in addition to providing communications with the spacecraft. The radio of the spacecraft transmits at a frequency of about 8.4GHz and receives at about 7.1GHz, in the X band. The spacecraft's radio is augmented by an ultra-stable oscillator, for use as a frequency source for the radio signal transmitted by the spacecraft during radio measurements of the Martian atmosphere. The radio science experiments will be made during periods when the signal transmitted by the spacecraft passes through the Martian atmosphere on its way to Earth, just before and after the spacecraft is hidden from view of the Earth.

The Pressure Modulator Infrared Radiometer (PMIRR) has the object of mapping three-dimensional and time-varying thermal structures of the Martian atmos-

phere, from the surface to an altitude of 80 kilometres. Other goals include mapping of the global, vertical and temporal variation of atmospheric dust and condensates. Measurements are made in nine spectral bands with five filter channels and two pressure modulator cells, one which contains carbon diode and the other water vapour.

The Magnetometer and Electron Reflectometer (MAG/ER) uses two triaxial magnetometers and an electron reflector, mounted on a six-metre spacecraft boom. The MAG measures the components of the magnetic field, providing the orientation and magnitude of the ambient field. The aims of the MAG are to establish the nature of the magnetic field of Mars, to map the Martian crustal remanent field using the sensors, and extend these measurements with the remote capacity of the Electron Reflectometer (ER) to characterise the solar wind and Mars plasma reaction. The ER instrument is being provided by the French space agency CNES.

The Mars Balloon Relay (MBR) is another instrument designed by CNES, to relay scien-



An artist's impression of the Mars Observer after arrival at the planet. An array of instruments will be used to study Mars in much greater detail than ever before.

tific telemetry from the balloons and landers that will be deployed at Mars by the Soviet Mars 1994 mission. Due to the changes in the former Soviet Union, the Mars 1994 mission has been tentatively postponed until 1996. The MBR system will be making use of computer memory of the *Mars Observer* Camera as a buffer, to enhance the telemetry return from the balloon suspended experiments which are expected to include imaging, atmospheric and other instruments. Given the realities of the former Soviet space program, the relay function may or may not take place in 1996 — which is a year after the expected end of the Mars Observer mission, although the spacecraft does have a design life of five years and will probably still be operating and sending data back to Earth.

The Mars Observer Camera (MOC), which was built by the California Institute of Technology, will produce horizon to horizon images with a resolution of approximately 230 metres. The telescopic images produced by the high resolution lenses are so fine that they will image less than 2% of the planet's surface at a time. The MOC is a significant improvement over previously flown imaging systems. It has no moving parts and its exposure times are set electronically. Line arrays are read off at an appropriate interval and arranged into a picture. The MOC has a 96-megabit solid state memory, the largest ever used on a planetary mission.

Power supply

The spacecraft is powered by an electrical power subsystem which will provide the generation, storage, control and distribution of electric power for the flight. During the launch, ascent and parking orbit, power is provided by nickel-cadmium storage batteries which are charged during the preparation for the launch. After separation from the upper stage, power will be generated by the solar panel array.

The solar panels are two and a half metres in diameter and four of the panels will be deployed soon after parking orbit. The two remaining solar panels will be deployed on arrival at Mars. The solar arrays are designed to provide sufficient power for operation of the spacecraft including power that is required to recharge batteries. The six panels of the solar array are arranged in a two by three matrix. They are capable of delivering a maximum load current of 30 amps to the electrical bus and 25 amps of battery charge current — a total output of 55 amps.

Two rechargeable nickel cadmium batteries consist of two packs. One of the packs contains nine cells and the other pack contains eight. The batteries are rated at 42.0 amp-hours and the system is designed to maintain operation with one cell shorted out.

Mission control

The Mars Observer mission operations at the Jet Propulsion Laboratory will be sup-

ported by the Deep Space Network and the JPL Space Flight Operations Centre. The science investigation teams will be located at the home institutions of the science principal investigators, team leaders and other key science personnel. Workstations and electronic communication links will connect the mission planning and data analysis activities of these scientists, engineers and mission managers.

NASA's Deep Space Network (DSN) will be used for communications between the *Mars Observer* spacecraft and ground controllers. The 34-metre high efficiency subnet, which is one of the newest DSN networks, has been selected to provide the daily uplink and downlink communications with the spacecraft at frequencies of about 7.2 and 8.4GHz respectively. The subnet will provide telemetry for the spacecraft at data rates from 7.8 to 500 bits per second, radiometric data, two-way Doppler, ranging and very long baseline interferometry, radio science and DSN monitor data. The DSN 70-metre telescope will provide periodic real-time high rate telemetry and radio science support.

The *Mars Observer* uses two types of data return: recorded and real time. For recorded data, the playback rates are 21.3, 42.7 and 85.3 kilosymbols per second — corresponding to record rates of four, eight and 16 kilobits per second. The 48.9 ratio between the playback and record rates was selected because in a typical eight-hour DSN tracking pass, due to Earth occultations, a minimum playback of roughly four and a half hours is available to return 24 hours of data.

The playback rates were selected to cover the range of expected telecommunications capabilities as the Earth to Mars distance will vary during the mapping phase. There will be a delay of up to 40 minutes each way for communication between Earth and the spacecraft (compared to 4.5 hours each way for *Voyager 2* at Neptune). The spacecraft has three tape recorders and they can store up to 48 hours of data at the four kilobits per second rate, and up to 12 hours at the 16kbps rate. The spacecraft has a high-gain parabolic antenna measuring 1.5m in diameter, and three low gain antennas.

The *Mars Observer* spacecraft was planned to be launched from the Cape Canaveral Air Force Station in Florida between 10.30am and 3.00pm (Florida time), on a date between September 16 and October 6th, 1992. If the launch window was missed altogether, it would be another two-years wait until the next launch opportunity.

The Titan III rocket has already been successfully used in the launch of INTELSAT satellites. The Titan consists of two liquid-propellant booster stages, with a solid rocket propellant motor attached to each side of the core vehicle for additional thrust. Titan can deliver more than 14,500 kilograms into low Earth orbit with a four-metre diameter payload fairing that accommodates all the payload requirements.

Making its flight debut this time was the Transfer Orbit Stage (TOS) which was built by the Orbital Sciences Corporation — who also built the *Pegasus* launch vehicle (see EA March 1990). The TOS is a single stage solid propellant vehicle.

The guidance and control of the TOS is based on a laser inertial navigation system developed for the US Air Force and Navy. The propulsion for the TOS consists of the main propulsion and reaction control systems, both developed from hardware used in both military and civilian space programs. A solid rocket motor provides the main propulsion system, pitch and yaw during motor firing, while a monopropellant hydrazine system provides reactor control system, velocity trim propulsion and roll control during the firing of the solid rocket motor. There are 1500 kilograms of propellant on board the spacecraft.

The Titan booster was designed to place the *Mars Observer* and its Transfer Orbit Stage upper stage into a parking orbit. After a coasting period, the TOS fires for 150 seconds and injects the spacecraft into a planetary trajectory. Some 12 minutes from the TOS burnout, the spacecraft separates from the upper stage and begins its deployment sequence. A few minutes after separation, the TOS performs a collision and contamination avoidance manoeuvre. The spacecraft should then have been acquired by the DSN tracking station at Tidbinbilla, just outside of Canberra.

The cruise phase is the period of transit from Earth to Mars, and will last 11 months. It begins when the *Mars Observer* separates from the TOS and ends at the beginning of the orbit insertion sequence at Mars, in October 1993. The orbital insertion phase is the period of transition from an interplanetary trajectory to the mapping orbit around Mars. The mapping phase is the concentrated science return from the mapping orbit. It begins when the *Mars Observer* spacecraft is declared ready for the collection of science data, and continues for one Martian year of 687 days.

There has been a great deal of cooperation on the *Mars Observer* project, between the United States and former Soviet Union. Besides the relay system being used for the Mars 1996 mission, 10 Commonwealth of Independent States scientists will be part of the science investigation teams.

The *Mars Observer* should answer many questions about the planet Mars, and will be a perfect reconnaissance craft for the scientists and engineers who are even now designing a human flight to Mars and eventual settlement of the red planet.

The author wishes to thank Dave Albaugh of the Mars Observer Project Office and Mary Harkin of the Public Information Office at the Jet Propulsion Laboratory, for their assistance in the completion of this article. All photos are courtesy of the Mars Observer Project Office at JPL. ♦

NEW BOOKS

Chopper odyssey

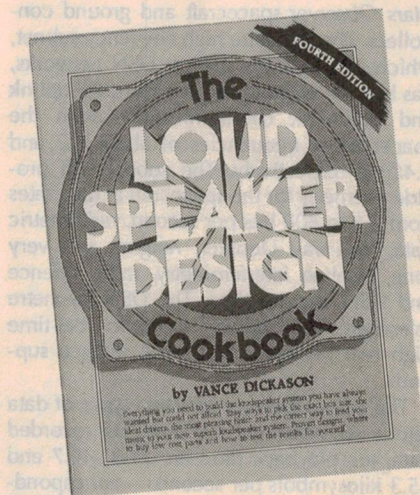
SOLO AROUND THE WORLD, by Dick Smith. Published by Australian Geographic, 1992. Hard covers, 365 x 263mm, 248 pages. ISBN 1 86276 008 X. Retail price \$39.95 plus \$6 packing and postage.

As well as being Australia's best known and most enthusiastic modern-day adventurer, my former boss and friend Dick Smith must surely also be our best known radio amateur. He tells me that during many of the lonely and more nerve-racking segments of his around-the-world solo chopper flights, his contacts with other radio amateurs were very important. Many times amateur radio links provided the only reliable contact with civilisation, as well as giving him the cheery support that kept him going.

When he rang up to ask if I'd like to review this new book (did I ever!), he also recalled an event that he'd found very moving — as well as a demonstration of the way that radio amateurs provide support with responsibility. During a particularly gruelling leg, over dangerous and remote territory, he was using amateur radio for hours on end to keep contact with his wife Pip. Not once, during that nerve-racking time, was there a single 'breaker' to disrupt the contact for selfish reasons. But when he landed safely at the end, and the danger was past, the band erupted into activity — hundreds of hams had been listening in, ready to assist in case of trouble, but had all waited discretely in the background!

In this book, he has provided an almost breathtaking record of his solo flights both around the world and around Australia, in his trusty Bell Jet Ranger helicopter *Delta India Kilo*. Looking through its pages and digesting its many beautiful pictures, two things really struck me. One is the incredible beauty of this planet of ours; the other is Dick's obvious fascination with, perhaps even love for, both the planet and its people as a whole — and our own island continent in particular.

It all makes fascinating reading, and I can warmly recommend it not only as a record of this facet of Dick's tremendous



personal achievements, but to anyone interested in helicopters and adventure. Congratulations, Dick.

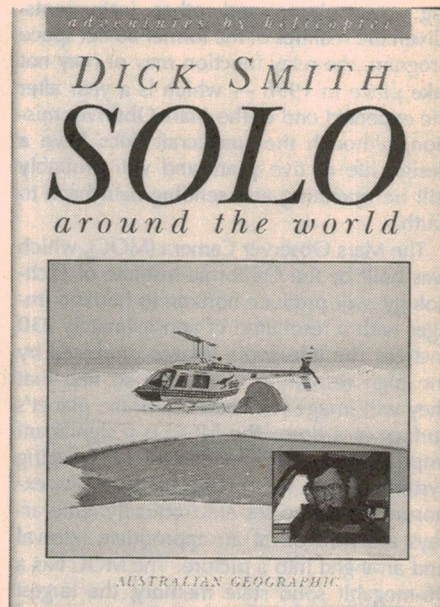
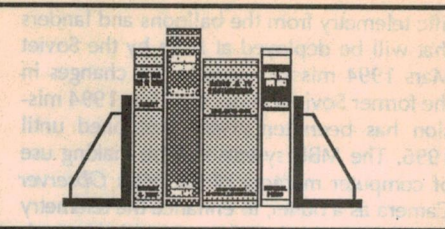
By the way it's only available direct from Australian Geographic, at PO Box 321, Terrey Hills 2084, or from the AG shops in Sydney, Melbourne and Brisbane. A companion video is apparently also available, for an additional \$24.50 plus \$6 P&P. (J.R.)

Loudspeaker design

THE LOUDSPEAKER DESIGN COOKBOOK, by Vance Dickerson. Fourth edition, published by Audio Amateur Press, 1991. Soft cover, 280 x 215mm, 142 pages. ISBN 0-9624-919-7-6. Retail price \$44.50, plus \$6 packing and postage.

This is the fourth edition of this popular do-it-yourself loudspeaker design book, which was first published in 1977 and has been progressively updated as new technology and techniques have appeared. In this latest version, the author makes extensive use of computer aided design (CAD) printouts to demonstrate many of the concepts involved in speaker enclosure design and tuning, giving the book a far more 'illustrated' look than before.

A complete chapter is now dedicated to CAD software itself, with a section



included for each of the most popular packages — these include LEAP (as used in our office), and the Australian developed CALSOD system. While the author doesn't attempt to discuss the actual operation of each program, each section takes a thorough look at the system's capabilities, and includes the current US price for comparison purposes.

Other chapters cover the basics of how loudspeakers work, the design principles of sealed, vented, passively-damped and transmission-line enclosures, cabinet construction, using mid- and high-frequency drivers, and active and passive crossover networks. Also included is a chapter showing several practical techniques for measuring the various driver parameters (Vas, Qts, Fo, and so on), which are needed by both manual and computer-based loudspeaker design methods.

Despite the increased attention paid to CAD systems for speaker design, the book still concentrates on practical ways to develop and refine your design, using a minimum of test gear. By using the large amount of information included in this book, and the author's guidance, the reader should be well-equipped to tackle even the most complex speaker designs.

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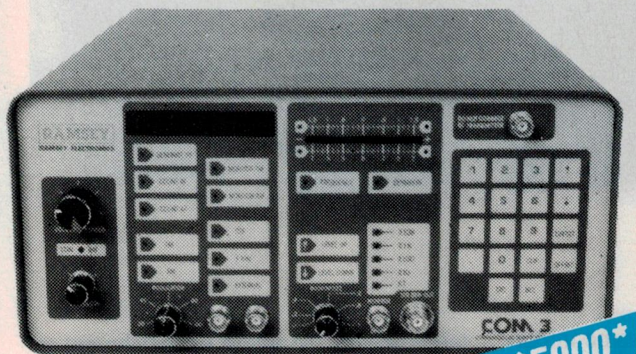
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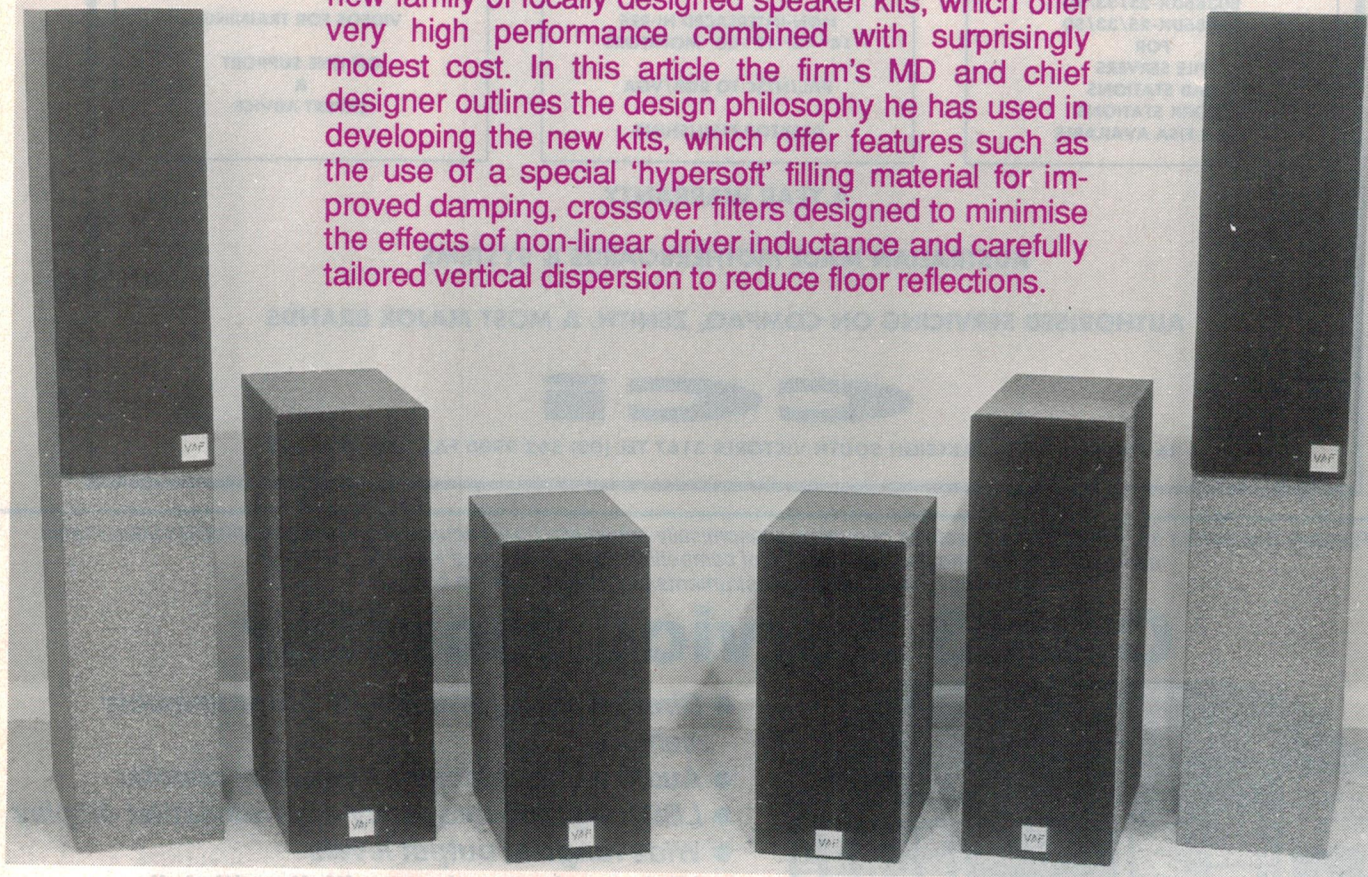
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READER INFO NO. 6

Australian designer explains how his

NEW SPEAKER KITS REFLECT FRESH THINKING

South Australian firm VAF Research has just released a new family of locally designed speaker kits, which offer very high performance combined with surprisingly modest cost. In this article the firm's MD and chief designer outlines the design philosophy he has used in developing the new kits, which offer features such as the use of a special 'hypersoft' filling material for improved damping, crossover filters designed to minimise the effects of non-linear driver inductance and carefully tailored vertical dispersion to reduce floor reflections.



by **PHILIP VAFIADIS** (Managing Director, VAF Research)

There are many speaker components and kits available, for those who wish to construct their own speakers.

Some of these kits have components of the highest quality, often seen in fully assembled speakers costing a great deal more; however they are usually compared to assembled speakers of similar cost and inferior components.

Although a few of these kits do offer reasonable performance for your money, they rarely extract the full potential of their components. As one of this country's few full-time professional hifi designers, I will attempt in this article to

give a brief introduction to some important aspects of speaker system design and will follow this with details of three new high quality kit speakers.

Many audiophiles dismiss intelligent and carefully conducted experimental evidence in favour of subjective listening tests, and yet they cannot always identify the specific causes of deficiencies in a system.

Similarly there is much opposition within the industry to quantitative design techniques; probably due to the mass market brands' over-emphasis on irrelevant specifications, and a reluc-

tance within the audio establishment to improve or even question their test methods.

It is not enough to use formulae and equations blindly, as they rarely include all the relevant variables. For instance, when designing crossover filters the basic equations only include the driver impedance at the intended crossover frequencies. Even if a Zobel network is used with the driver, there will still be a slight variation of impedance with frequency and this will have an effect on the actual filter characteristics (Fig.1).

The design equations also ignore the

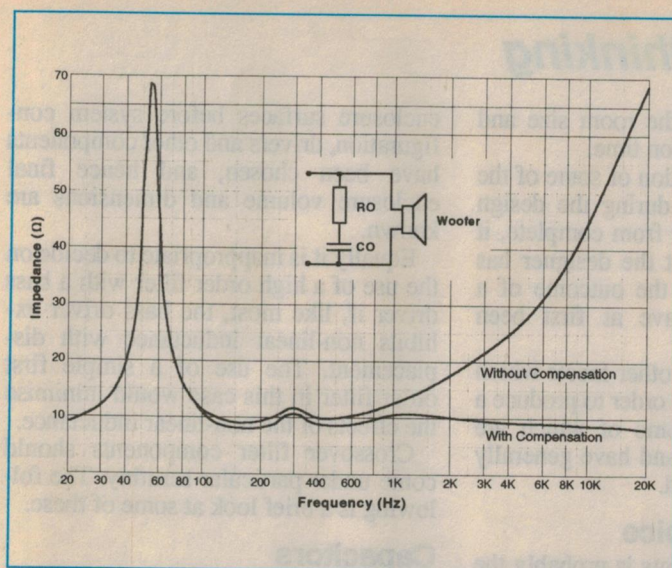


Fig.1: The impedance curve of a woofer in a closed box, with and without a Zobel compensating network. There is still some variation, although rather less than before.

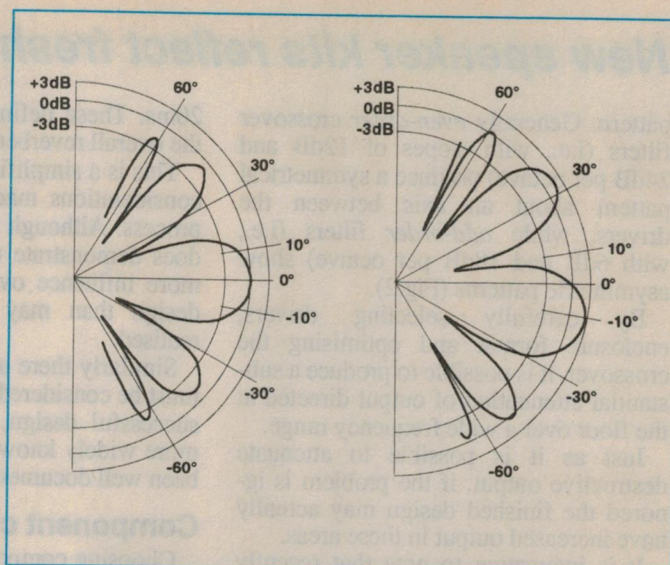


Fig.2 An even-order crossover gives a symmetrical vertical radiation pattern for a two-way system (a), while an odd-order crossover (b) can be used to tilt the pattern.

complex reactive nature of all of the electrical components in the filter. The only way to calculate a filter response reasonably successfully is by complex 3D vector analysis of each and all components — but this still ignores interactions with enclosures, associated electronics and the intended listening environment.

Because of this complexity, subjective evaluation and technical analysis are each inadequate. A combination of the two, used with the benefit of experience, generally yields the best results.

Basic considerations

In general a hifi system should, as near as possible, re-create the original sound source in the user's listening environment. Obviously your budget will have some effect on the system's ultimate performance, as more compromises in design and construction must be made as the budget reduces.

Although it may not be realised when listening to music, the sound may be divided into four basic categories as follows:

1. The direct signal, which is the signal that travels from the speakers directly to the listener without reflecting off or being obstructed by anything.
2. Signals that are delayed less than 1ms as a result of reflections or refractions, off speaker enclosure boundaries and other objects close to the speaker.
3. Signals that are delayed by 1 - 20ms as a result of reflections or refractions off speaker enclosure boundaries and other objects in or around the listening area.

4. Signals that are delayed more than 20ms. These would be signals that are reflected off objects or walls at the periphery of the listening area.

Category (1), the direct signal component, communicates the position and scale of the source. This is the area where most designers concentrate their efforts. It is essential for this category to have a flat frequency response and a smooth phase variation with frequency. This is usually quite easy to achieve

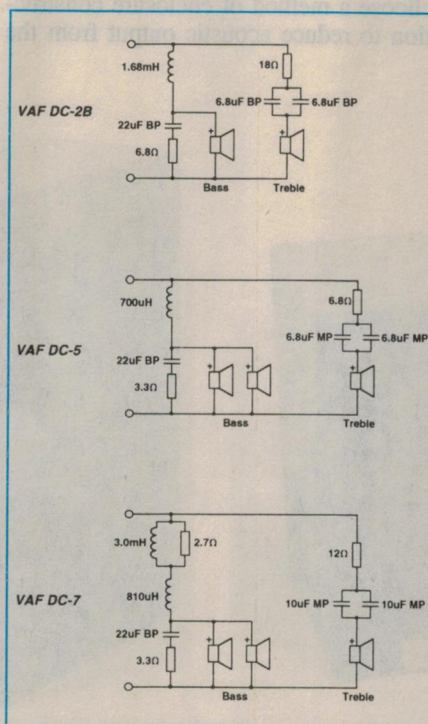
using passive equalisation techniques, and with cabinet construction that minimises reflections and refractions of signals that would appear as delayed sources.

Specifically, this may include the use of step filters and/or notch filters, resonance cancellation and impedance compensation networks and the use of absorptive and/or diffusing materials on the speaker baffle. The normal design process has the potential to achieve this, but still completely disregards the fact that the speaker usually will end up in a domestic environment (i.e., on or near the floor with furniture randomly arranged in the same room).

Now consider category (2) signals, which are delayed less than 1ms. Assuming no objects or walls are close to the speakers, the most destructive reflection (other than those off the enclosure itself) is off the floor immediately in front of the speaker.

In many systems this reflection results in signal delays of less than 1ms. Depending on the frequency, the human ear has difficulty distinguishing these signals from the direct source. I perceive sounds from systems with such reflections as cluttered, having slurred transient decays and reduced detail. Rather than ignoring the problem, it is possible to tailor the vertical dispersion patterns of a speaker system and hence diminish the destructive effects of this reflection.

In two-driver systems where both drivers are arranged vertically, the vertical radiation pattern is produced by the interaction of the output of drivers at all frequencies where both drivers have output. This interaction results in a lobing



Here are the crossover circuit schematics for each of the three systems.

New speaker kits reflect fresh thinking

pattern. Generally *even-order* crossover filters (i.e., with slopes of 12dB and 24dB per octave) produce a symmetrical pattern about an axis between the drivers, while *odd-order* filters (i.e., with 6dB and 18dB per octave) show asymmetric patterns (Fig.2).

By carefully selecting drivers, enclosure format and optimising the crossover, it is possible to produce a substantial attenuation of output directed at the floor over a wide frequency range.

Just as it is possible to attenuate destructive output, if the problem is ignored the finished design may actually have increased output in these areas.

It is interesting to note that recently several prominent manufacturers have promoted speakers which they claim have a wide vertical dispersion. It is just a pity that most people have floors in their houses!

The category (3) signal components, with delays of 1-20ms, create the tonal balance and give the clues which define the positions of objects in and around the listening area. In most listening areas the horizontal dispersion of the speaker should be very wide; consistent output should be achieved over a minimum of 100° over most of the frequency range. Output beyond these limits should reduce smoothly.

Finally we come to the category (4) signal components, with delays of over

20ms. These define the room size and the overall reverberation time.

This is a simplification of some of the considerations made during the design process. Although far from complete, it does demonstrate that the designer has more influence over the outcome of a design than may have at first been realised.

Similarly there are other facets which must be considered in order to produce a successful design, some of which are more widely known and have generally been well documented.

Component choice

Choosing components is probably the most time-consuming part of the design process. For example, it is important that there be a smooth phase transition from one driver to another; it may not be realised until some time has been spent on a design that it is impractical or impossible to achieve this, while still achieving other desired goals.

When designing a speaker system it must always be remembered that all component parts have inter-relations with each other. Each aspect of the design must be accomplished with full consideration of all other aspects of the system.

For instance it seems illogical to choose a method of enclosure construction to reduce acoustic output from the

enclosure surfaces before system configuration, drivers and other components have been chosen, and hence final enclosure volume and dimensions are known.

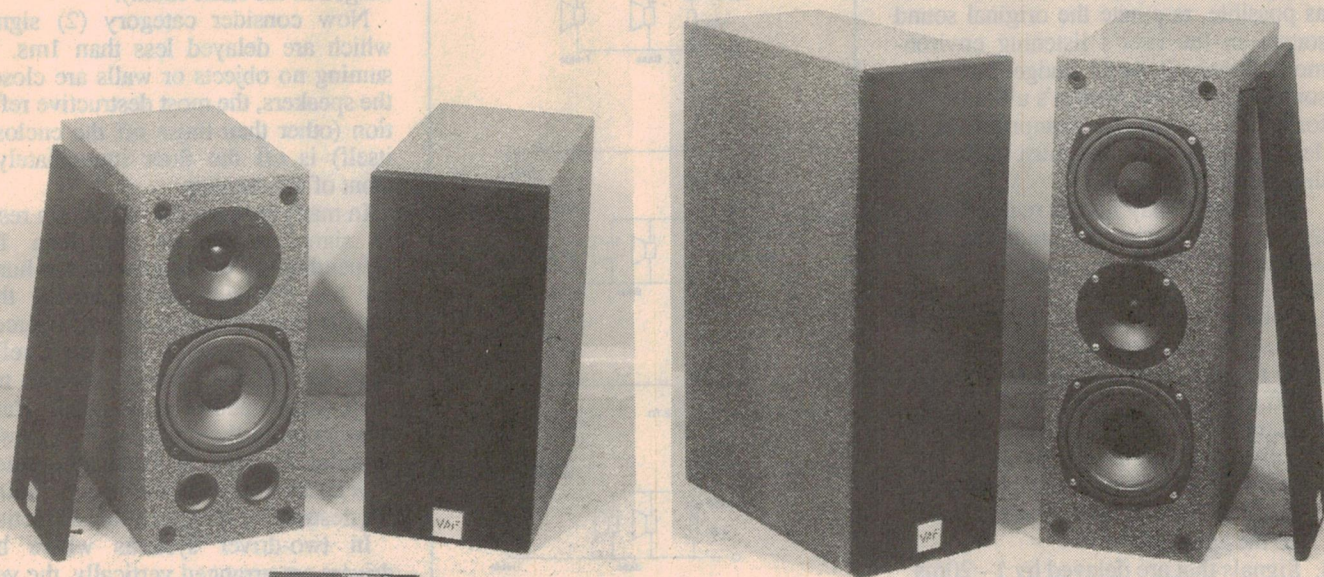
Equally it is inappropriate to decide on the use of a high order filter with a bass driver if, like most, the bass driver exhibits non-linear inductance with displacement. The use of a simple first order filter in this case would minimise the effects of the non-linear inductance.

Crossover filter components should come under particular scrutiny. The following is a brief look at some of these.

Capacitors

Capacitors are a particular headache. Metallised film capacitors are more suitable in speakers than electrolytic types. They usually have a lower dissipation factor, lower equivalent series resistance, better high frequency and temperature stability, higher over-voltage and pulse handling capability, lower self inductance and in some instances have better self-healing characteristics.

Substitution between types of capacitors in filter circuits will result in different filter Q's. Other aspects of performance will also be affected. These aspects include transient response, frequency response and phase response. While these effects are widely known, others are not. For example, the induc-



Smallest system in the new kit family is the DC-2B, a compact two-way bass reflex design that offers surprisingly clean and deep bass.

The middle DC-5 system is still a two-way enclosure, but uses two of the bass drivers in a sealed box. This gives significantly higher power handling capability.

tance of long capacitor leads has a measurable effect on the dissipation factor at frequencies as low as 1000Hz.

This is not to say that electrolytics should never be used. When their limitations are fully understood, reasonable performance may still be realised in some applications. On the other hand some manufacturers go to the extreme of silver mica capacitors in high frequency filters.

Resistors

Considerations of resistors are fairly straightforward, however a couple of things should be remembered. Firstly resistors used in speakers should be as non-reactive as possible over audio frequencies. Wirewounds should be used carefully, as they have significant inductance. Secondly their resistance must stay constant over the range of voltages and temperatures they are likely to encounter. Also resistance variations with frequency must be quantified, in order to analyse their effect on other components.

Some resistors found in many speakers have less resistance at higher frequencies. When these are used to attenuate driver output, then there will be less attenuation at higher frequencies.

If the driver has reduced output at these frequencies then they may be a good match; however if the driver's output *increases* at these frequencies then these types of resistors should not be used for attenuation, and more stable resistors or a different method of attenuation should be used.

Inductors

Properties of inductors have been well documented. In most high quality designs air-cored inductors are favoured over ferrite cored inductors.

Given identical inductance and DC resistance, both types of inductors will have identical Q's; however cored inductors are ultimately capable of lower DC resistances.

I believe air cored inductors make more sense in speakers, as the money spent chasing slightly lower DC resistance is usually better spent elsewhere in the system. Cores that will operate properly over the full audio bandwidth and that will not saturate with the high currents encountered in modern systems are not freely available, and would be quite expensive.

Inductors used in series with bass drivers should have sufficiently low DC resistance to maintain a damping factor of at least 5:1 at the driver. If an amplifier has an output impedance of

0.01Ω, and the speaker cables, connectors and series inductor have a combined impedance of 0.5Ω at 100Hz, then if this is feeding a driver with an impedance of 5Ω at 100Hz, the overall damping factor is 10:1 at the same frequency.

This is one reason why passive filters are not suitable in speakers with crossover points below about 250-300Hz. If a bass driver is crossed over below this

range of frequencies, the reactance of the series inductor feeding it would be quite high at bass frequencies. This would be sufficient to eliminate a great deal of electrical damping.

Enclosures

For enclosures, different design approaches must be taken for 'one offs' as opposed to those intended for produc-



The largest system in the family is the DC-7, which again uses two bass drivers but this time, in a rear-ported bass reflex box. A more sophisticated crossover is also used, giving very clean and deep bass right down to below 40Hz.

New speaker kits reflect fresh thinking

tion. It is not uncommon for me to build and test eight or nine boxes when working on a production design.

Vibrations and resonances will occur no matter how the enclosure is built. The trick is to use them to advantage, or to minimise their effects on the system's performance.

Given the same surface area and amplitude of panel deflection, panels with lower resonant frequencies will have lower output. Conversely, we can make very stiff panels having resonant frequencies out of the audio band, or at least high enough that the internal damping of the panel itself is sufficient to kill the resonance. This kind of experimentation is unrealistic for a 'one off', and for these the designer's experience with previous systems must be used almost exclusively.

As I have said, the intention of this article is to give a brief introduction to some important aspects of speaker system design. The kit designs which will now be described should give a further insight into the relevance and application of these ideas.

VAF's DC Series kits

I have designed this range of speakers to be of truly audiophile quality. While there are other kit speakers available in the same price range, I claim that none have been conceived more comprehensively, and none offers the same fine and balanced sound quality.

There are three speakers in this new range as follows:

The VAF DC-2B

This is a compact two-way design intended for use on stands or on a shelf. This speaker produces remarkably clean and deep bass (-3dB at 55Hz) for a cabinet of such small proportions. It is suitable for systems with up to about 50 watts per channel, and is ideal for people on a budget who don't want to compromise quality and don't need extremely high volume levels.

The VAF DC-5

This is a larger version of the DC-2B using two bass drivers per enclosure, aligned in a vertical symmetrical array about the tweeter. This speaker offers high sensitivity (91dB/W) and a higher 70-watt power handling. Note that either the DC-2B or the DC-5 would make excellent surround speakers in an uncompromising home cinema system.

The VAF DC-7

This is an elegantly slim floor standing speaker with the same driver array as

EDITOR'S NOTE

VAF Research very kindly sent us assembled samples of each of their new speaker system kits, so that we could judge them for ourselves. This allowed us to carry out listening tests, and also run the systems through our test setup based on Audio Teknology Inc's 'LMS' PC-based analysis system.

The curves we obtained with LMS agreed quite closely with those provided by VAF, and reveal all three of the systems to offer a smooth and well-balanced response — with the larger systems admittedly a little better in this regard than the DC-2B.

In listening tests we were very impressed with the systems, all of which offer really excellent performance, especially when their relatively modest price is taken into account.

The DC-2B system inevitably doesn't have the bass response or power-handling capability of the larger systems, and

also has a trifle less 'presence'. However its performance is still very smooth and clean (including transient response), and it would be a good choice where space is restricted and very high sound levels are not required.

Both of the larger systems have more than enough power handling capability for the majority of domestic situations, and both have a particularly smooth and well-balanced response with very clean transients. The largest DC-7 system has particularly impressive bass response as well, although the DC-5 is in no way disappointing here either.

We would recommend that people building the DC-7 system invest in the optional mounting spike set, however. The DC-7 enclosures are relatively tall for their slim footprint, and thus tend to be a little unsteady when placed on a carpeted floor. The spikes should overcome any tendency towards instability.

the DC-5, but with a different enclosure and a more sophisticated crossover.

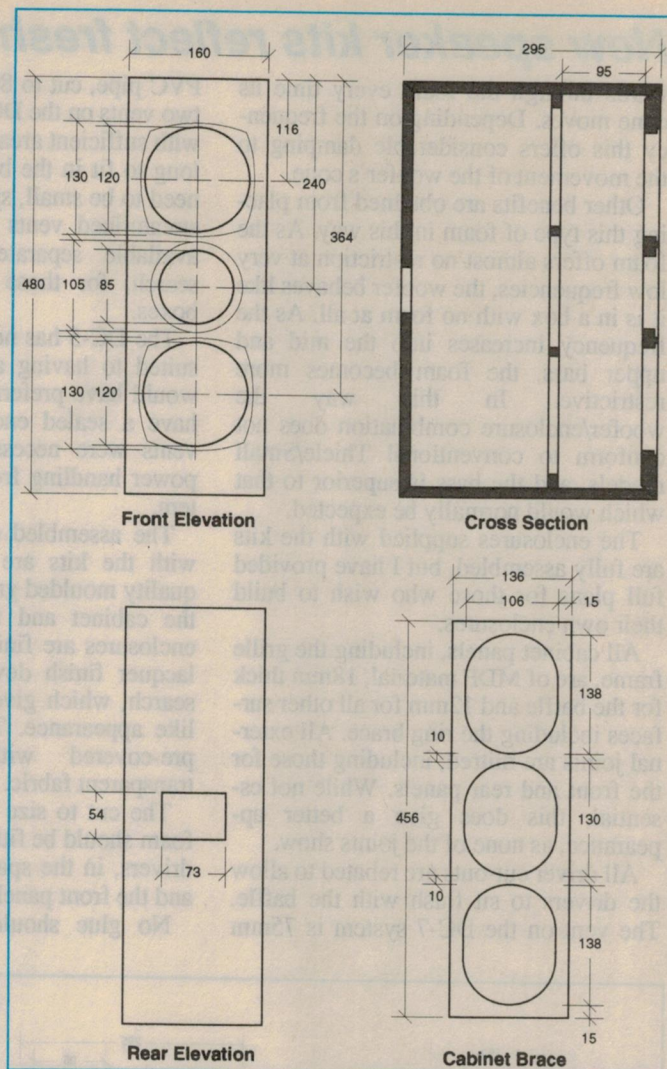
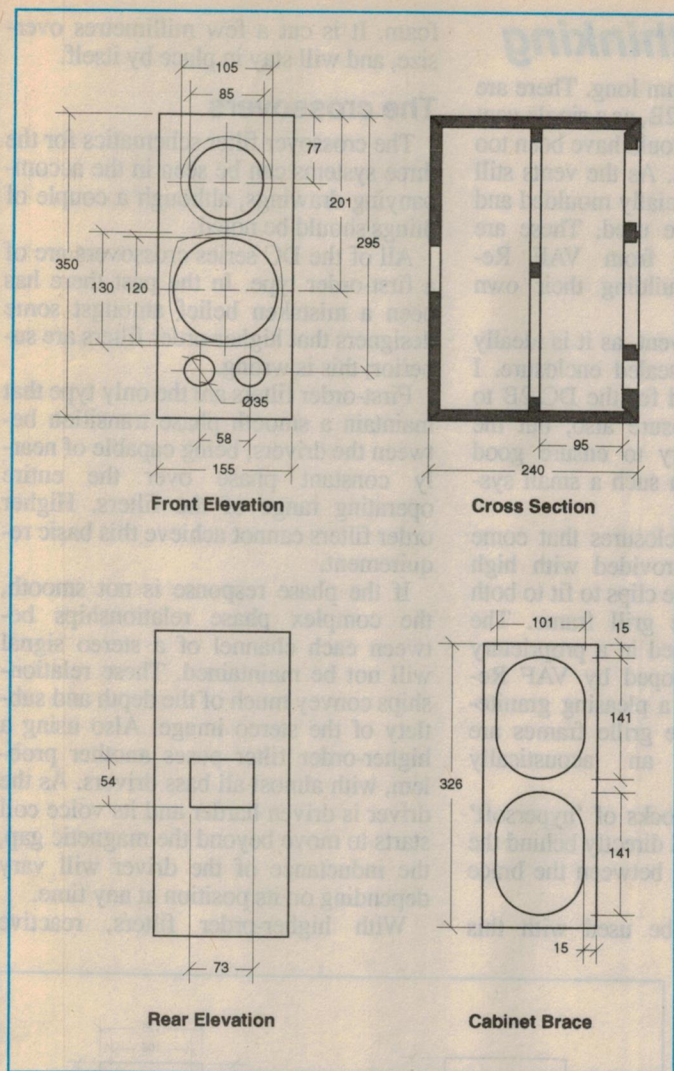
This design produces clean and deep bass to under 40Hz and is capable of providing a very deep and open sound stage. It is suitable for systems of up to 80 watts/channel.

It should be noted that as with all

speakers, these power ratings are just a guide. I would recommend that people buying their first amplifier should buy quality first and then as much power as they can afford. A quality high power amplifier used sensibly is likely to do less damage to a speaker than a medium power one driven 'flat out' into clipping.



A close up of the drivers used in the new series of speaker kits. The tweeter (right) uses a 25mm high loss dome, coupled to a double chamber rear housing and with magnetic fluid damping. The 130mm woofer has a rigid diecast frame.



Here are all of the dimensional details for the DC-2B system (left) and DC-5 system. The material used is MDF, 18mm thick for the baffles and 12mm thick for all other surfaces including the internal brace.

All of the DC series speaker systems are based on the same drivers, with less compromise in the crossovers and cabinets up through the range.

The drivers

The drivers used in these kits are of a higher quality than any drivers used in any commercial speaker kits at the same prices.

The tweeter is particularly sophisticated. It uses a 25mm high loss dome, fitted behind a shallow horn and coupled to a double-chamber rear housing. The shallow horn improves the air load on the dome, while the double-chamber construction considerably reduces ringing after transients. Furthermore, this tweeter's voice coil is immersed in magnetic fluid and is terminated with very compliant flexible braids.

The magnetic fluid helps to dissipate heat generated by the voice coil and also provides damping to the diaphragm's

movement, further improving this tweeter's impressive ability to resist ringing on transients.

The flexible voice coil braids are very compliant, having little effect on the movement of the dome and this together with the double-chamber construction yields a very low resonance frequency of about 700Hz. Tweeters of this calibre are usually not found in imported speakers under \$2000!

The bass driver is exclusive to VAF Research and is also a high quality unit. It is 130mm across and features a rigid, non-resonant die-cast frame, not the cheaper pressed steel types usually found in products at this price level. It also has a curved polypropylene cone and a treated soft, but dense foam roll-surround, giving the unit a very smooth response. A good magnetic circuit and a powerful magnet complete this very capable bass unit.

Constructors should ensure that the

size of the cut-out hole for this driver is accurate, as most of the driver's 130mm diameter is used to move air leaving under 5mm mounting clearance around the edges.

Cabinets

The cabinets in these systems are an integral part of the overall designs. The woofers and the cabinets are designed to work together to produce the bass output. In most speakers, whether bass reflex or sealed boxes, there is a free space of air directly behind the woofers. This air acts as a spring, which becomes part of the woofer's resonant system. Unfortunately this offers little damping of the woofer's movement leading to pronounced ringing on bass transients.

To avoid this problem, these new systems are designed so that there is a piece of special 'hypersoft' foam, directly behind the woofers. This requires each woofer to move air forward and back-

New speaker kits reflect fresh thinking

wards through the foam every time its cone moves. Depending on the frequency this offers considerable damping to the movement of the woofer's cone.

Other benefits are obtained from placing this type of foam in this way. As the foam offers almost no restriction at very low frequencies, the woofer behaves like it is in a box with no foam at all. As the frequency increases into the mid and upper bass, the foam becomes more restrictive. In this way the woofer/enclosure combination does not conform to conventional Thiele/Small models, and the bass is superior to that which would normally be expected.

The enclosures supplied with the kits are fully assembled, but I have provided full plans for those who wish to build their own enclosures.

All cabinet panels, including the grille frame, are of MDF material, 18mm thick for the baffle and 12mm for all other surfaces including the ring brace. All external joints are mitred, including those for the front and rear panels. While not essential, this does give a better appearance, as none of the joints show.

All driver cut-outs are rebated to allow the drivers to sit flush with the baffle. The vent on the DC-7 system is 75mm

PVC pipe, cut to 80mm long. There are two vents on the DC-2B, as a single vent with sufficient area would have been too long to fit in the box. As the vents still need to be small, specially moulded and streamlined vents are used. These are available separately from VAF Research, for those building their own boxes.

The DC-5 has no vent, as it is ideally suited to having a sealed enclosure. I would have preferred for the DC-2B to have a sealed enclosure also, but the vents were necessary to ensure good power handling from such a small system.

The assembled enclosures that come with the kits are provided with high quality moulded grille clips to fit to both the cabinet and the grill frame. The enclosures are finished in a proprietary lacquer finish developed by VAF Research, which gives a pleasing granite-like appearance. The grille frames are pre-covered with an acoustically transparent fabric.

The cut to size blocks of 'hypersoft' foam should be fitted directly behind the drivers, in the space between the brace and the front panel.

No glue should be used with this

foam. It is cut a few millimetres oversize, and will stay in place by itself.

The crossovers

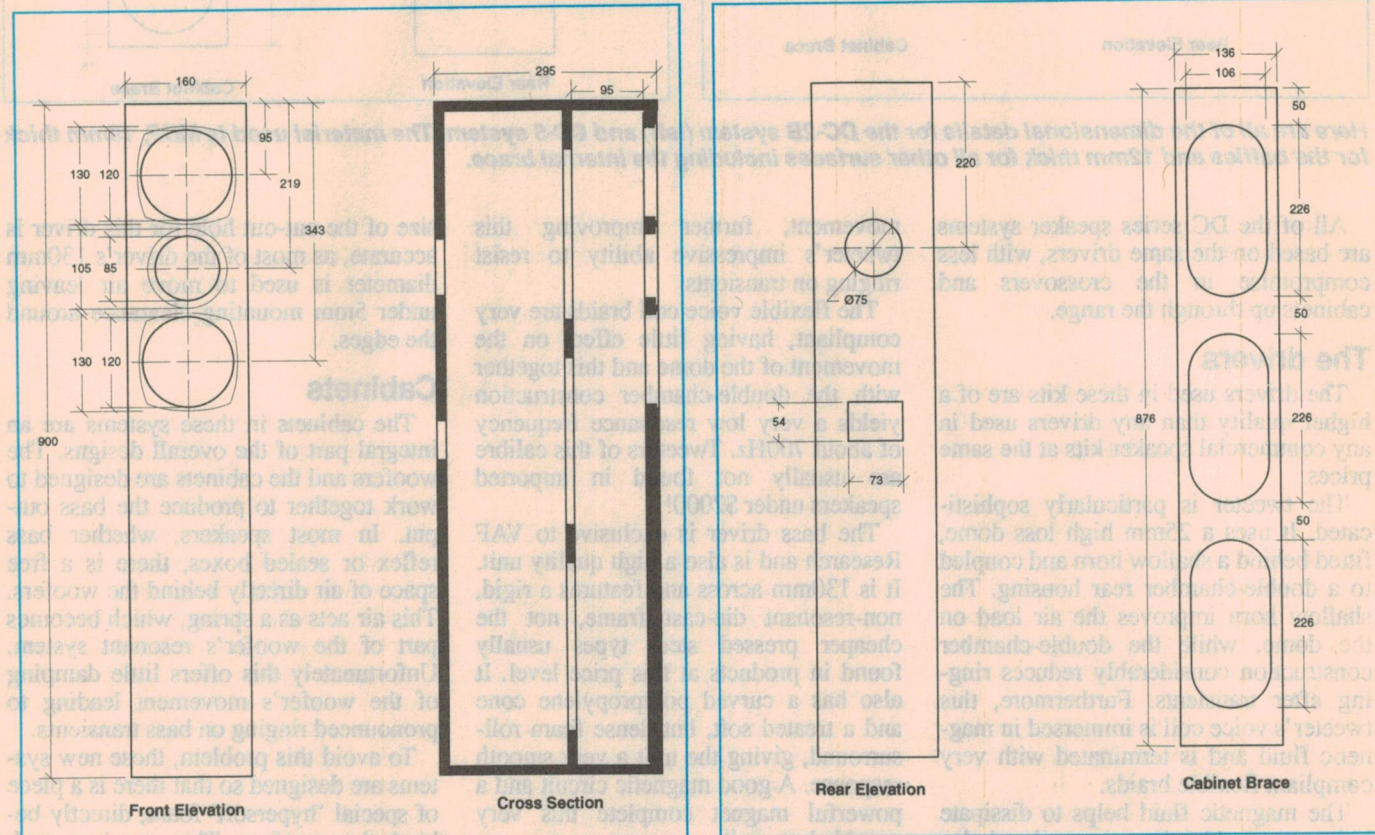
The crossover filter schematics for the three systems can be seen in the accompanying drawings, although a couple of things should be noted.

All of the DC series crossovers are of a first-order type. In the past there has been a mistaken belief amongst some designers that higher-order filters are superior; this is wrong.

First-order filters are the only type that maintain a smooth phase transition between the drivers, being capable of nearly constant phase over the entire operating range of the filters. Higher order filters cannot achieve this basic requirement.

If the phase response is not smooth, the complex phase relationships between each channel of a stereo signal will not be maintained. These relationships convey much of the depth and subtlety of the stereo image. Also using a higher-order filter poses another problem, with almost all bass drivers. As the driver is driven harder and its voice coil starts to move beyond the magnetic gap, the inductance of the driver will vary depending on its position at any time.

With higher-order filters, reactive



Here are the cabinet details for the DC-7 system. It too is made from 18mm and 12mm MDF material.

crossover elements are connected in parallel and in series with the driver. When the driver's inductance becomes non-linear with excursion, the crossover's effect on the driver will vary

dramatically — depending on what the driver is doing at that instant in time. This is readily evident on many speakers by the obvious deterioration of sound quality as the volume is increased.

With first-order filters, however, there is a simpler set of problems which are not exaggerated by parallel reactive crossover elements. A bass driver's inductance may vary from, say, 1mH to 600uH when driven beyond its linear capability, and this may be fed with an inductor of 1.5mH in a typical system.

In this combination of circumstances the total inductance would vary from 2.5mH to 2.1mH, a variation of about 15%. This variation will only have a small impact on the control of the crossover on the woofer, with a first-order filter.

The crossover circuits for the DC-2B and the DC-5 are similar. However the component values are different, and the capacitors feeding the tweeter are metallised polypropylene in the DC-5, as opposed to the bipolar type used in the DC-2B.

A step filter is used in the DC-7 system's low-pass section. This allows the deepest frequencies to pass interrupted by only the small DC resistance of the 3mH inductor. As the frequency increases the inductor's impedance rises, diverting the signal through the 2.7Ω resistor. This results in a maintenance of good electrical damping at low frequencies where it is needed, and a flat response in this enclosure. The DC-7 high-pass section uses metallised polypropylene capacitors. All DC series inductors are wound from heavy 1mm wire and are resin bound. All resistors are ceramic with over 5W capability. The terminals used are very heavy-duty gold plated types that allow either connection via banana plugs or directly by cable of over 5mm in diameter.

Assembly

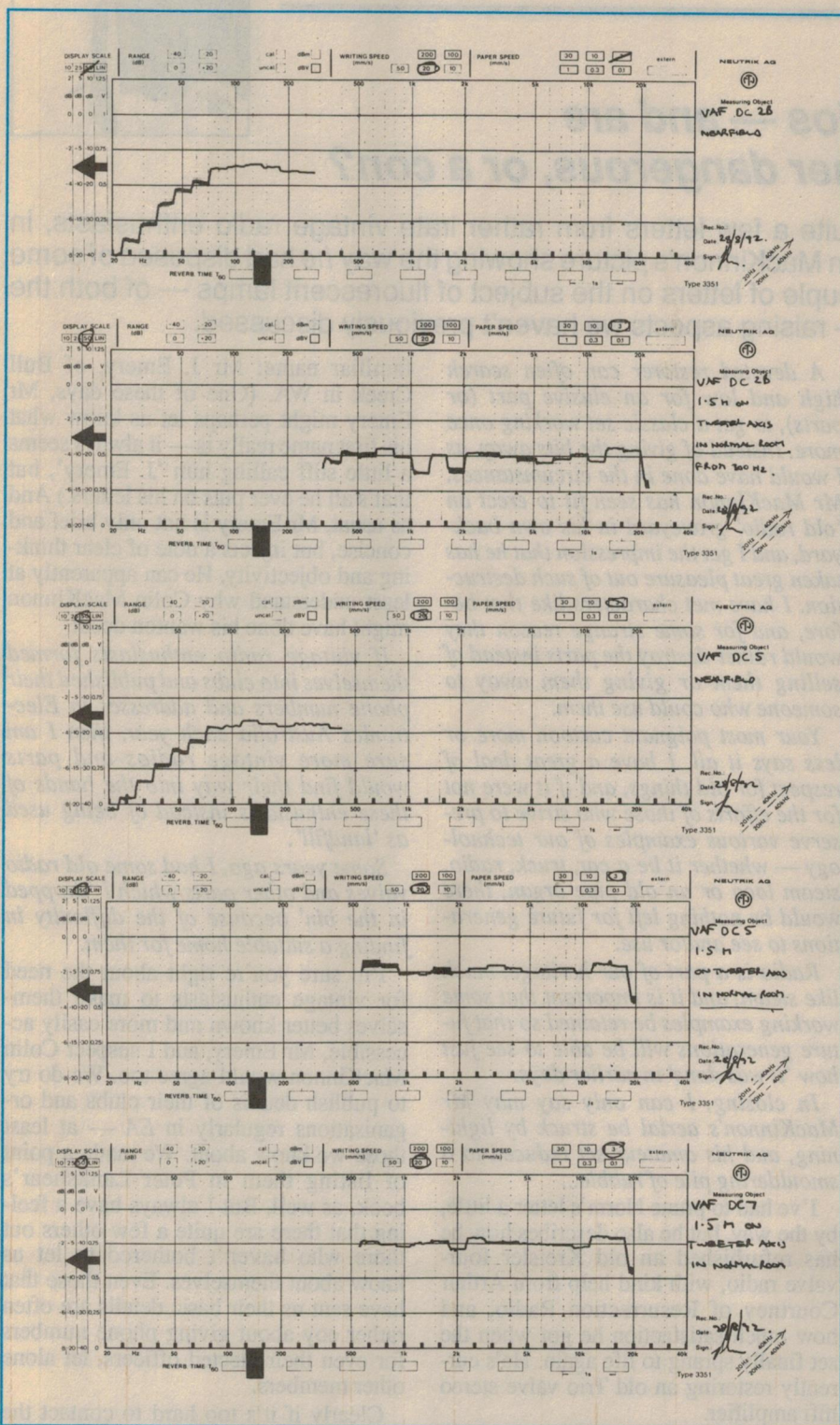
Assembly of the kits is straightforward and requires only basic skills and tools. The cabinets are already assembled and finished, and the crossovers are pre-assembled with hookup wires attached.

First fit the crossovers in place. The DC-2B and DC-5 crossovers are already mounted on the terminal plate, which has a sealing gasket already fitted. This is easily screwed in from the rear through the hole provided.

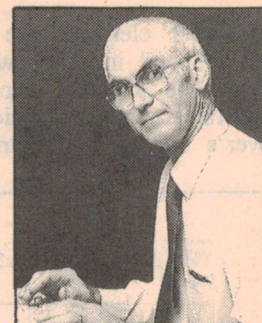
With the DC-7 the crossover is pre-built on a separate board. This should be glued to the inside of the back panel between the vent and terminal cutouts. The input wires are then passed through the terminal cutout and soldered to the terminals.

Check at this stage to ensure the cor-

Continued on page 94



Here are the performance plots for the three systems, with the DC-2B plots at the top, those for the DC-5 in the centre and the DC-7's response above 550Hz at the bottom (a low frequency plot was not available at press time). The bass responses are plotted separately because of the need to make near-field measurements at these frequencies to avoid room resonance complications.



Disposing of old radios — and are compact fluoro's either dangerous, or a con?

As I half expected, there were quite a few letters from rather irate vintage radio enthusiasts, in response to our publication of Colin MacKinnon's picture showing the way *he* had disposed of some old sets. I've also had a further couple of letters on the subject of fluorescent lamps — of both the compact and 'long tube' variety — raising aspects we haven't previously discussed.

I guess it was pretty predictable that we'd upset quite a few readers, with our publication of Colin MacKinnon's picture in the August column. Not just because it showed how he had used some fairly classic old radios to help fill in a hole in his backyard — which was bound to upset almost every vintage radio enthusiast, in itself — but because he seemed almost proud of having done so!

Actually there was a further reason, which I didn't explain in the August column for fear of allowing Colin to be identified too easily, but which can probably be mentioned safely now (especially as we're shortly going to be publishing a couple of his articles). This is that Colin is actually quite active in one particular area of vintage radio preservation and study: military radio, radar and related fields.

As it happens, *some* readers turned out to be well aware of this other side of our supposed 'vintage radio vandal', and this of course only made them even more upset. How *could* someone with such a keen interest in preserving old radio gear and history in one area, be prepared to chuck examples of another kind of radio into a hole in the ground?

Anyhow, I suppose in even explaining this background, I'm stealing a bit of their thunder. So without further ado, let's look at a sampling of the kind of response we received. Here's an extract from a letter from our old friend Norm Bush, of Canterbury in NSW:

My blood pressure suddenly increased after reading the item headed 'Vintage Horror' in the August issue. I felt angry, sad and upset to see and read about such a blatant waste of potentially re-useable radio parts, particularly when there are devoted restorers such as Peter Lankshear and others who could have made use of any salvageable parts.

A devoted restorer can often search high and low for an elusive part (or parts), to get a classic set working once more. Instead of giving the bits away, as I would have done in the circumstances, Mr MacKinnon has seen fit to erect an 'old radio' graveyard in his own backyard, and I get the impression that he has taken great pleasure out of such destruction. I have met characters like that before, and for some strange reason they would rather destroy the parts instead of selling them or giving them away to someone who could use them.

Your most poignant cartoon more or less says it all. I have a great deal of respect for old things, and if it were not for the efforts of those who strive to preserve various examples of our technology — whether it be a car, truck, radio, steam loco or an old pipe organ, there would be nothing left for future generations to see and/or use.

Radio is a part of our heritage, much like steam, and it is important that some working examples be retained so that future generations will be able to see just how 'it was done' in earlier days.

In closing, I can only say may Mr MacKinnon's aerial be struck by lightning, and his amateur set reduced to a smouldering pile of rubble...

I've had to prune Norm's letter a little, by the way, but he also describes how he has refurbished an old Kreisler four-valve radio, with kind help from Arthur Courtney of Resurrection Radio, and how much satisfaction he got when the set finally sprang to life again. He's currently restoring an old Trio valve stereo hifi amplifier.

Thanks for your contribution, Norm. I'm sure you weren't hoping Colin would be inside his ham shack when the lightning struck, though — were you?

A letter also arrived carrying another

familiar name: Mr J. Emery, of Bull Creek in WA. (One of these days, Mr Emery might perhaps let us know what his first name really is — it always seems a little stiff calling him 'J. Emery', but that's all he ever puts on his letters.) And as usual, Mr Emery is not only brief and concise, but injects a note of clear thinking and objectivity. He can apparently at least understand why Colin MacKinnon might have done his wanton deed:

If vintage radio enthusiasts formed themselves into clubs and published their phone numbers and addresses in Electronics Australia each year, then I am sure more vintage radios and parts would find their way into the hands of these enthusiasts instead of being used as 'landfill'.

Some years ago, I had some old radio valves and other parts which I 'dropped in the bin' because of the difficulty in finding a suitable home for them.

I'm sure you're right about the need for vintage enthusiasts to make themselves better known and more easily accessible, Mr Emery, and I suspect Colin MacKinnon would agree too. We do try to publish details of their clubs and organisations regularly in EA — at least those we know about. We made a point of listing them in Peter Lankshear's book, as well. But I always have a feeling that there are quite a few others out there who haven't bothered to let us know about themselves. Even those that have sent us their basic details are often rather coy about giving phone numbers for even their elected officers, let alone other members.

Clearly if it's too hard to contact the committed enthusiasts, a lot of people with old gear will simply take the easy way out and dump it. You can't blame them, really — not everyone wants to spend all of their spare time and cash in



preserving the past, even though they may respect and even applaud those who do want to.

Anyway, thanks for your comment, Mr Emery.

And talking about vintage radio clubs, another rather less understanding letter came from the Editor of the Historical Radio Society of Australia's newsletter, Mr Tony Zuiderwyk (VK3ZMP). Needless to say Mr Zuiderwyk was aware of Colin MacKinnon's other identity:

I wish to express my absolute horror at the contents of Colin MacKinnon's letter.

Apart from Colin's total disregard for the history of wireless, which I liken to blasphemy, I am most concerned that he may be mistaken for another Colin MacKinnon. This Colin is well known for his preservation of history; his impressive collection of military radios and his numerous contributions to the newsletter of the Historical Radio Society of Australia, attest to his dedication. Certainly these two people cannot be one and the same!

With his tongue firmly in his cheek, could the real Colin MacKinnon please stand up?

Well, Tony, I'm not sure whose tongue is planted further in their cheek — yours or Colin's. So perhaps we'd better leave

it at that — Except that I can't resist one comment myself.

Apart from this letter from Tony Zuiderwyk, I really can't remember receiving any other correspondence directly from the Historical Radio Society of Australia. The main reason why I myself have even known of their existence has been the fact that Peter Lankshear has included them in his annual listings of clubs and societies.

It looks as if Mr Emery is pretty right, in his suggestion that Tony and his fellow enthusiasts haven't been all that good at making themselves known to the world at large. It's all very well producing newsletters to spread the word among your fellow enthusiasts, folks — but if you are not casting your nets further afield, you really shouldn't be surprised when people throw old treasures in bins or holes in the ground...

Anyway, I'm going to suggest that the HRSA sends us regular copies of its newsletter, so we can try to help them publicise their activities better. And the same offer applies to other societies and clubs, too.

Since I've taken our vintage radio columnist Peter Lankshear's name in vain, it's only fair that we let him have the last word about Colin MacKinnon's letter

and picture. As you might expect, he couldn't resist a comment — not so much in anger, but bemused sorrow:

My August copy of EA has arrived, and of course I am bemused by the photograph sent by Colin MacKinnon of his 'graveyard', and by his attitude. Still, I guess that he is not unique. History is full of incidents of this nature. After all, the term 'vandal' comes from the attacks on Rome in 455 AD, when uncivilised Germanic tribes destroyed many fine and beautiful buildings and works of art.

However, the laugh may be on Colin! If his description of the contents of that pile are correct, he destroyed what he could have sold readily today, for several thousands of dollars...

Thanks, Peter, and I'm happy to let you have the last word on that topic, at least for the present.

Fluoro lamps

Now let's turn again to the subject of fluorescent lamps. You may recall that I wrote a column on the new compact fluoro's in the September 1991 issue, and there were follow-up discussions about these in later issues. Well, there's been a couple of belated responses to this discussion, both of them bringing up aspects that we didn't cover previously. So

I thought we'd spend the rest of this month's column looking at these.

The first letter came from Mr Frank Rushworth, of Allambie Heights in NSW, who is concerned about the area of health and safety:

You spoke very knowledgeably on certain aspects, mainly power consumption and efficiency, but could you please extend your investigation into other areas?

As you mentioned, these lights work by creating UV energy and then converting this to visible light. But nothing is perfect, and the long fluorescent tubes have a leakage of UV energy which continuously bombards the workers who sit closely under them all day long.

There have been some medical studies to investigate the world wide rise in malignant melanoma and there is persuasive evidence that it is not mere coincidence that the rise in melanoma took place along with the rise in world wide fluorescent use. (I refer you, for example, to a study by the London School of Hygiene and Tropical Medicine and the University of Sydney Malignant Melanoma Clinic, titled 'Malignant Melanoma and Exposure to Fluorescent Light at Work', published in the Lancet of August 1982.)

The tubes leak some UV when they are new. I assume that if you have old tubes in which some of the phosphor coating has cracked off the glass, the UV must pour out.

So, how do these new types of fluorescent tube compare with the older type as regards UV leakage? Could you test this factor, compared with the older type, and with other types of illumination?

The makers of the long tubes have certainly tried to correct the colour balance, but speaking generally, the fluorescent tube has far too much harsh light at the blue end of the spectrum. Many people go home with eye strain headaches each day, and have to wear glasses to correct fairly minor refraction errors.

Without particularising any one manufacturer, some of the people who make these lamps are quite aware of the problems, but say "It is up to the community and the medical profession to decide what they want — so long as an architect designs a building and specifies 8000 fluorescent tubes in it, we are going to manufacture them".

There are problems with this argument, because most of the technical data and most of the complaints are known only to the manufacturers.

Maybe it is time for the community to

be active against this unhealthy lighting. My ophthalmic specialist does not have a fluorescent light source in his rooms, and he advises against them. But on the other hand the NSW Government sends me a power account along with an 'offer' from Philips to change over to that company's compact fluorescent lamps, and receive a rebate.

So, in short: (a) do the new lamps have as much UV leakage, which may eventually kill some users, and (b) are the light balance and the light flicker any better, or will we have as many headaches?

Well, there are Mr Rushworth's comments and questions. As you can see, the area he's drawn attention to is certainly one we didn't look at before. And I guess that's because things like the relationships between UV radiation and melanoma, and colour balance and eye strain, are really well outside our particular field of modest expertise. Still, I imagine that the cancer researchers and ophthalmologists might not be all that good at measuring electrical efficiency, or looking at the harmonic content in lamp currents, either. (At least I hope not, or we might end up out of a job!)

Still, Mr Rushworth has certainly raised an interesting aspect concerning these lamps. We electronic types tend to be rather impressed by their high electrical efficiency, and this aspect inevitably also has a big appeal for building owners and their accountants. But if spending long hours working in their light causes a demonstrable increase in the likelihood of our getting skin cancer and to a lesser extent eye strain, we may well be ignoring a much more serious cost factor.

I don't know about you, but Mr Rushworth's letter has certainly made me want to find out more about the UV leakage levels from both conventional 'long tube' fluoro's and the new compact variety. It's an interesting point, because my understanding of the new tubes is that they do use a higher density of plasma and UV inside the tube, compared with the older type — so there just might be a risk of higher UV leakage, even though the conversion efficiency of the new phosphors is also said to be improved by the same extent.

I'm also going to try and get a copy of that report on the relationship between malignant melanoma and fluoro's, in the hope that it can be understood by we non-medico electronics folk.

As for us doing some measurements on the UV leakage levels, I suspect that would be rather more difficult than it sounds. For one thing, UV measurement gear is neither readily available nor cheap. I also seem to recall reading

somewhere recently — probably in a copy of *New Scientist* — that there are actually only a couple of specific UV wavelengths that are believed responsible for causing things like melanoma. So presumably it's only radiation at these wavelengths that is of real concern, not UV radiation in general.

This would actually make measurement of the UV levels even more difficult, because you'd need a very selective metering system.

Mr Rushworth's question about colour balance may not be all that easy to answer either. My impression is that the phosphors used in most of the new compact tubes give a rather more 'warm' and balanced light than many of the conventional long-tube fluoro's, but I can't remember seeing any published spectrum plots for either type, to provide hard evidence either way.

He asks also about flicker. Conventional long-tube fluoro's do have quite pronounced 100Hz flicker, due to the way that the internal mercury-vapour arc is extinguished between each AC half-cycle. I may be wrong, but it seems to me that the new compact fluoro's would have just as much flicker, for the same basic reason.

As far as I can see, the only possible way that the flicker could be reduced is if the phosphor could somehow introduce an energy 'storage' effect, by absorbing excess excitation from the UV during the arc pulses, and releasing it during the 'gaps'. But I haven't seen any suggestion that this happens, in any of the manufacturer information...

Sorry, Mr Rushworth, but at this stage there don't seem to be too many answers to the questions you raise!

And finally, let's look at the other letter on compact fluoro's, which came from Mr Ian Baker of North Fitzroy in Melbourne. Mr Baker is an engineering student, as you'll see, and he too raises an aspect that we didn't look at earlier:

It is my understanding that the Victorian State Electricity Commission (and other state authorities) support and promote the use of compact fluorescent lamps, as they reduce 'green house' emissions and save consumers money. I, however would like to pose the question: are we being duped by the introduction and liberal promotion of compact fluorescent lamps?

As a fourth-year engineering student, I often find it interesting to apply material learnt in one subject to the problems posed in another.

In quality control lectures, we learn that to refine (improve) a process, you should eliminate/solve the problem



Consulting engineer Arthur Spring sent in this picture of a 1000uF 25VW electrolytic cap body, now embedded in his workshop ceiling. It was driven there when the cap exploded, an event which also covered his workbench in what Arthur describes as a 'brown elder-down' of gunk. But why did the cap explode — when the 25W PA amplifier he was developing had been turned OFF for about two minutes? Because he was powering it from a poorly regulated 24V power supply, whose unloaded output voltage rose above the cap's rated voltage. He says it made "...a helluva loud BANG!"

which has the largest effect on the process first, then tackle the smaller ones. The good thing about this academic axiom is that it makes good intuitive sense as well!

In this case the 'other subject' is Context Curriculum, in which we study (amongst other things) the relationships between technology and society. A study of the breakdown of domestic energy consumption by the SECV showed space heating/cooling as the largest portion, at 50%. Lighting came in last, at just 2%.

Given the quality control axiom stated above, why then do we spend so much effort on an aspect of the problem which has least significance? It's like trying to boil the billy with the flame of a lighted match!

A cynical person might say that if you were running an industry that consumed non-renewable resources at one end, to produce electricity and plenty of pollution at the other, you'd be looking for a way to get an environmentally friendly reputation, to remove any focus from your not-so-environmentally-friendly activities. If, into the bargain, you could convince people that they were 'doing the right thing' whilst having the least

effect on your core product, all the better. So — Hey, Presto — the compact fluorescent lamp!

Subjects such as these can be difficult to discuss. People who persist in drawing 'black and white' conclusions about a topic whose parameters are defined in shades of grey are dancing a jig in a minefield.

However, if we ignore the fact that these lamps use a mixture of magnesium, sodium and fluorine gases that are highly toxic pollutants when the lamp is discarded, and only consider the logic of the situation outlined above, we can safely suggest that these lamps are not all that they are cracked up to be. Concentrating on ANY other aspect of domestic energy consumption will help the 'Green House' problem more than these lamps will.

Thanks for your thoughts too, Mr Baker. And I guess one can't argue with the broad thrust of your argument — that because domestic lighting constitutes such a small proportion of overall power consumption, the emphasis on compact fluoro's seems rather misplaced.

I must confess that your description of what a 'cynical person' might conclude from this also has a certain amount of appeal, too. But perhaps that's just because I'm a cynical old magazine editor — after all, your description couldn't be true, surely. The electric power authorities are *much* more sincere than that...

Cynicism aside, though, I'm sure that compact fluoro's were not developed either purely, or even primarily as a token product to pacify the Green lobby. Like many products nowadays they were basically a development from existing products (existing long-tube fluoro's), as a response to market demand for a lamp that would provide an efficiency close to that of the existing type, but in a more compact form and one that would be more compatible with all of those domestic fittings designed for traditional incandescent lamps.

So although domestic lighting *does* only form a relatively minor component of overall power consumption, once the new lamps had been developed it surely made sense to promote their use — wouldn't you agree?

Mr Baker is no doubt right in suggesting that in order to make much more impact on the global warming problem, and on the rate of depletion of non-renewable resources, we'll need to focus a lot more on other areas of power consumption — like space heating and cooling, and so on. The trick is going to be persuading research bodies and commercial firms to do this, I suspect.

What will probably happen is that things will proceed in the usual piecemeal and haphazard fashion, as a result of developments in specific areas of technology and also in response to particular market needs. But this might still bring about a worthwhile and significant change — look what has happened with microwave ovens, a purely 'commercial' development which must have resulted in quite a significant drop in power consumption for both domestic and commercial food heating.

So I don't think compact fluoro's are some kind of massive 'commercial con trick', Mr Baker, even though there's a fair bit of logic in your general argument about priorities...

By the way, where did you get the information about compact fluoro's containing a mixture of magnesium, sodium and fluorine gases? That's new to me, I must say. The information I've seen talks about bismuth and indium in addition to the basic mercury vapour, for the basic plasma-supporting mechanism, while the phosphors contain cerium, thorium and other rare-earth materials. Of course mercury is pretty toxic, and some of the others are not very nice either, but I wasn't aware that sodium and fluorine were also present.

If you have some more information to clarify this point, I'm sure other readers would be interested as well.

And that's about all we have space for, this month. I hope you'll join me again next time, because I have some interesting information on another product which is claimed to enhance the performance of CD players. This one seems to have a bit more technical justification, too... ♦

HI-FI:

AN INTRODUCTION

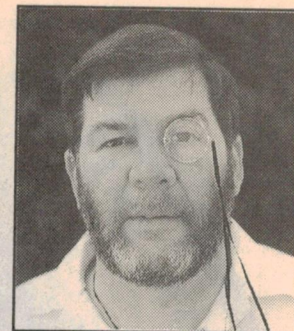
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Moffat's Madhouse...

by TOM MOFFAT



Shot down by the dreaded stocktake

Life ain't easy, is it? Here we are, still deep in a recession/depression; everybody's complaining about falling sales, falling incomes.

(Even panelbeaters, I see, in Melbourne, are squawking about decreased incomes, because Victoria's new speed cameras are reducing the number of road smashes. Poor panelbeaters! Not enough prangs nowadays — not enough death, not enough injury, not enough paraplegics. The implication is that the government should *do* something — let the road toll climb back to normal again, so that the panelbeaters can prosper?)

In our industry, electronics, companies are complaining that business is crook. So they are cutting back on stock, reducing the number of lines, saving a buck here and there. And they appear to be cutting back on service as well. At the end of the line are poor sods like us who must have access to electronic goods for our own business to survive. My own little mail-order kit operation recently suffered a gut-wrenching trauma that caused me two weeks and two days of sheer misery. And I was only trying to get some parts — just a few simple parts.

You might recall the weather satellite project, that began in the June *EA*. It turned out to be immensely popular. I had the parts already laid in to do 50 kits, but they disappeared in the first 10 days. Then I needed parts for 50 more kits, quick. Should be no problem — a quick order, and we'll have them in a few short days. Oh yeah?

At that stage Tasmanian schools were on holidays, so I decided to take the kids down to our beach shack and wait the few short days there, doing some writing. Once the parts arrived, our little break would be promptly terminated and I'd go back to work: day and night shifts until another 50 kits were ready.

On the fifth day I got the message: the parts had arrived.

When I went to pick them up, parts had arrived all right; some of them, but certainly not all. Some resistor and

capacitor values were missing, and to produce kits you obviously have to have EVERYTHING at hand, or you can't make up one lousy kit.

What about the rest of the parts? "Ah, well; they should be here tomorrow morning".

Tomorrow morning arrives, so I get on the phone: "They arrived yet?"

"Well, no. Maybe they didn't make the overnight air freight — but I'm sure they'll be here TOMORROW morning."

The next day: "Well, we'll check with (Company A) to make sure they've sent them". And the next day: "(Company A) says they've definitely sent them. Try back in a couple of days".

A couple of days, and numerous phone calls later, still no parts. Why don't we get the consignment note number from Company A and then try to trace the shipment through the air freight company? Done.

We find that the parts did arrive in Tasmania, and the carrier had a signed receipt of delivery — to the wrong address. What address? Don't know.

The local supplier now gives in, and offers to order the whole lot of parts again from Company A. They will be sent overnight and will definitely be here 'tomorrow morning'.

Tomorrow morning arrives, no parts. The next day arrives, still no parts. Company A says, "Oh, they've definitely been sent".

My customers starting to ring asking "Where IS my Wesat kit?". I say the parts are held up. I know what they're thinking — "Oh yeah, same old bulldust". And I don't blame them.

I finally give up on Company A and the local supplier, and approach Company B in Sydney direct, on their toll-free mail order hot line. They give a firm guarantee that if I get an order to them before 11:00am, it will be filled at 12:00 and sent out by overnight air that day.

Company B's prices were somewhat higher than those of Company A, but there was that watertight guarantee that I

would have the parts 'tomorrow'. So I fired up the computer and dashed off an order for all the missing resistors and capacitors — plus some more for the next 50 kits as well, just to be safe. I got the order onto the fax well before the 11:00 deadline.

Company B rang back and confirmed that the order had been received. And they again guaranteed that the parts would indeed be leaving that very afternoon.

The next day — Hey, Surprise! — no parts from Company B. No parts from Company A, either. I decided to let the matter ride a couple of days, with no phone calls to either company, and spent the time receiving calls instead from people asking "Where's my Wesat kit?".

Aaannnd another day passed... No parts from Company B's 'instant overnight service'. But Company A finally came good! Except, that is, for OA91 diodes. There were a few — the last from Company A. This multinational outfit had decided that germanium diodes were no longer a modern stock line, so they'd dropped them. For people who need germanium diodes for their applications, tough!

What had happened to Company A's shipment anyway? Phone calls to their dispatch department had always resulted in the programmed response "your order's on the way", but a call to the firm's managing director revealed the truth: no shipments had been made for several days, because the company was undergoing 'stocktake'.

They just hadn't bothered to tell their customers, and particularly that fellow in the shipping department who kept spouting "your order's on the way".

This whole sorry business caused considerable embarrassment to the local supplier, who just kept passing on to me the platitudes from Company A. When the stuff finally turned up they graciously delivered the goods to my door, in the middle of a blinding rainstorm. My kit factory was finally up and running

again, and 16 days after the first lot of parts ran out, we were shipping kits once more.

However, the parts ordered overnight from Company B were still in limbo — now into their fifth 'overnight'. Were they lost in shipping? I rang the mail-order hot line yet again: "Yes, Sir, your shipment will be leaving this very afternoon".

But what happened to the promise to ship on the first afternoon? "Well, we haven't been able to ship anything because we've been in (wait for it) stocktake".

I laughed a little. I sniggered. I think I cried a little. The guy on the other end of the phone must have thought I was bonkers. Stocktake! Yes, I guess it had to be. Promise them this, promise them that, get their orders, and then to hell with them.

The parts from Company B did turn up the next day, but they wouldn't have done much good, even if they had arrived on time. The order was short the required 10k resistors, and had two lots of 2.2k instead. And I couldn't prepare any kits without 10k resistors. Oh well, 'near enough is good enough', I guess...

This leaves me in a quandary. Two of Australia's biggest component suppliers have let me, and my customers, down with a litany of bulldust and excuses which were clearly untrue. These were not just silly mistakes — they appear to have been carefully calculated and executed untruths. Should we shed a tear for them when they complain that 'business is crook'?

Because of the triple ordering there are enough parts here *now* to do another 150 kits. But after that, what? Do I start approaching overseas suppliers directly? Maybe that's the solution, and leave the locals to whinge about 'poor business conditions is Australia'.

On the other hand, if Australian companies would just be honest with their customers, maybe we could be more tolerant of them. Had Company A or Company B said "I'm sorry, but we can't ship any goods for five days because we're doing a stocktake", then maybe we'd put up with it.

We wouldn't be too happy, but at least we could have some truthful answers to pass onto our own customers, left wondering what happened to THEIR orders.

Mould storage

Still on the kit business — sort of — here's a sad tale and something for you computer people out there to watch out for. While waiting and waiting for the

above parts to arrive, I spent some time making copies of the software disks that go out with every kit.

I've got this mass-copier program. You feed the master disk to be copied into it to get it started. Then you just feed it blanks, like cookies to the Cookie Monster, and it regurgitates carefully formatted, recorded, and verified copies.

I'd done perhaps 50 or 60 of these, and then run out of disks. But I realised I had another supply stored under the house along with my most junky radio gear, busted chairs, the hot water cylinder, etc. This area isn't good for much else, it has a dirt floor, but it's a useful place to hide stuff you don't want to see for a while.

I brought up three more boxes of these under-house disks and proceeded to feed them into the Cookie Monster. But after the third one or so the computer started complaining about 'bad disk' and rejected them. This was odd, because the disks were the same good quality brand I'd been using all along. I tried a couple more, and the computer promptly spat them out.

Then when I put one into the B drive, it started squealing 'screee...' and I knew something was terribly wrong. I tried an old disk of my own in the drive, and again 'SCREEEEEE!!!'. It was obvious that disk drive was shot.

But then the A drive started doing the same thing — rejecting disks and squealing for all it was worth. Total disaster!

A quick look at the surface of the under-house disks revealed what was wrong. Instead of a nice shiny even brown colour, they had darker brown blotches and even some things that looked like flecks of black paint.

Closer investigation by microscope at the Botany Department of the University of Tasmania revealed that the blotches looked like spider-webs — closely matted at the middle and radiating outward.

Mould! The damn things had gone mouldy, from the moisture and damp earth under the house. And now the mould had clogged up both the disk drives on my trusty XT computer, used for all my disk copying.

I got some of those extra-long cotton buds and dipped them in liquid freon, and then tried cleaning the disk drive heads. Great blobs of grot came off onto the cotton. I kept doing it over and over until the cotton buds came back clean, and then I tried the drives with some disks.

The squealing had stopped, but there were still read errors. More scrubbing

the heads with freon improved things, and eventually the drives seemed restored to normal. But I still won't trust them for a while; every disk copied will be compared against the original until I'm 100% sure the drives are OK.

I think they will survive, because the computer is fairly old and was supplied with the very highest quality Japanese drives. They look pretty rugged anyhow. I suspect a more modern computer with 'cheapie' drives could have been in real trouble from the mould attack.

So you've learned something today: Never, *never*, NEVER store disks under the house. Other things have gone mouldy under there, and I should have known. The disks were stored in strong plastic boxes, protected against any rats or other vermin, but they must not have been very air-tight.

Now I wonder what's happened to some of the other stuff I have stored under the house. I think I'm afraid to look... ♦

PC-Based CIRCUIT SIMULATORS An Introduction

Computer programs capable of simulating the performance of complex analog circuits can now be run on many personal computers, heralding a new era in the design of electronic equipment. In the future, much of the tedious design hack-work will be performed on a PC, providing faster and more accurate results than bench testing.

Find out more about this rapidly growing technology, with our new publication *PC-Based Circuit Simulators*. Based on a popular series of articles run recently in the magazine, it gives an easy to read introduction to circuit simulators, plus an unbiased evaluation of the main simulation packages currently available.

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An easy to understand introduction!

GETTING INTO PACKET RADIO: A GUIDE FOR HAMs & LISTENERS

Inveterate project/kits developer Tom Moffat has just finished his latest masterpiece: a new easy to use, low cost modem which turns an IBM-compatible PC into a terminal for full transmit-receive operation on amateur packet radio networks — the 'Pocket Packet'. But before *EA's* editor Jim Rowe would let him describe it, he set Tom a challenge: to explain the arcane mysteries of packet radio, at least in basic form, for those who've found previous explanations unhelpful. Here's the result, with the Pocket Packet itself set to follow next month...

by **TOM MOFFAT, VK7TM**

A few months ago, a NASA space shuttle went into orbit — carrying among its crew some ham radio operators. Their intention was to communicate with other hams on the ground as they flew overhead. But when would the shuttle be coming over? What frequencies would they use?

Within a few hours of launch, I had a data file sitting on my computer disk, ready to feed into my Traksat program. This would tell me exactly when the newly launched shuttle would be visible from Hobart, which direction it would be from here, and what angle it would reach above the horizon.

Sitting on the screen of my laptop computer was a schedule of the astronauts' ham operation, what frequencies they would be using, and even what names they would like to be called by. There was also information on frequencies to be used for general communication with NASA, and with tracking stations around the world.

For operational reasons, the shuttle's amateur operating frequencies subsequently had to be changed, but I knew about it almost as soon as the astronauts did (see Fig.1). Since space shuttles are in low earth orbit, their orbits decay fairly quickly and orbital parameters more than a day or so old become kaput. But I kept getting fresh orbit calculations long before the old ones ran out. How? By packet radio.

On one occasion I fired up my computer, hooked it to my VHF ham transceiver, and was immediately rewarded with a personal letter from a fellow I went to the Antarctic with. He

was now a radio astronomer, resident in — Chile!

How did I get that letter? By packet radio. His word processor had tossed his letter, along with my amateur callsign, into the worldwide packet network. It had found its way to my computer in Hobart, automatically.

Poking around on 'packet radio bulletin boards' you'll find information of interest to everybody. One text file I collected recently described a project by hams in Argentina to place a digital repeater on the surface of the moon. Pie in the sky? Probably not. It looks like they've got NASA backing. This particular item was in Spanish, reflecting its place of origin.

If you want to know what people are saying about proposed changes to amateur radio regulations, just look at the stuff flying around the packet radio network. You'll find some opinions expressed — how should we say — quite forcefully!

Want to fiddle with some new software, particularly stuff that's radio-related? It's all there for the taking, ready to be downloaded via packet radio. Packet radio!

It seems everybody's getting into it, or wanting to get into it. It's just like two-metre repeaters were 20 years ago, or single-sideband transmission 40 years ago — a few pioneers first, followed by the whole world. And I'm told by the radio authorities that they're receiving inquiries all the time from people without ham licences, who just want to LISTEN on packet. They've got VHF scanners, but no way to decode packet.

Problem solved: the construction

project described in the next article of this series is capable of decoding and displaying everything that happens on the packet radio frequencies.

But — does even the name 'packet radio' send shivers up and down your spine? Possibly so; packet seems to have become the 'black art' of radio communication. If you happen to stumble upon a magazine article about packet, you soon find yourself swimming through a sea of TNC's, NRZI's, HDLC's, and FCS's.

This series is going to be 'different' (I hope). This month we'll swing the sword of sensibility to slash through the C.R.A.P. (Confusing Radio Abbreviations — Packet). You won't end up a packet expert (is anybody?); but if you are a radio amateur you should be able to come up on air with ease and hold your own with the best of them. And if you're not a licensed amateur, you'll still be able to open a gold mine of jolly good listening.

Coming: a project

Next month, we will describe a project called 'POCKET PACKET' — a packet MODEM (MODulator/DEMODulator), smaller than a pack of cigarettes. Pocket Packet plugs into the serial port of your IBM-compatible PC, and draws its operating power from the computer itself. The modem then connects via a cable to a VHF-FM radio, be it a two-metre amateur base, a mobile, a scanner, or an HT (Handheld Transceiver, or 'walkie-talkie').

If the computer happens to be a battery-powered laptop, and if the radio is a handheld, we then have a totally portable

packet radio installation that can be easily hand-carried to a lovely beach or even to a mountaintop, where it can act as a 'DIGIPEATER' (digital repeater) for sporting events or search-and-rescue missions.

If after reading this introductory article you'd like to have a crack at packet, you can purchase your Pocket Packet kit and have it up and running in time for the next gripping installment of this series. Ordering information is at the end of this article. (OK, Tom, enough of the commercial. Let's get going with that introduction to packet — Ed.)

Packet radio basics

An amateur packet radio station is simply a communications terminal, hooked into a worldwide network of similar communications terminals. You could compare it with a telex machine, those things we used before we all got fax

machines. With a telex you could send a typed message anywhere in the world (for a price, of course), and anyone in the world with a similar machine could send messages to you. All you had to do was punch in a number (an ADDRESS) and your message would be automatically routed to that address.

With packet radio you have a home computer instead of a mechanical telex machine, and operation is free. Text is presented to you nice and clean and error-free, just like it came out of the word processor on the other end. Information is broken up into messy looking chunks as it's transmitted (see Fig.3), but your computer sticks it all back together into the original document.

Message handling is much the same as with telex, except that items intended for you do not come directly to your home. Most are routed only as far as a nearby 'Packet Radio Bulletin Board' (BBS),

where they are held for your collection. It is like having a post office box — your mail stops there, and you must physically turn up to collect it.

But to collect your mail via packet radio, you need only switch on your gear and CONNECT with the BBS. When it answers, it will tell you if you have any mail waiting. Your ADDRESS is your ham callsign, which is passed to the BBS as part of the connect procedure.

Knowing the callsign, the computer looks up your name and then comes back with something like 'Hello Tom, you have new mail waiting...'. In fact you don't even have to connect; many BBS's periodically transmit a BEACON signal advertising their presence, and the beacon usually carries a list of who the BBS is holding mail for.

Bulletin Board Systems are packet stations just like yours, operated by people who are real enthusiasts. Instead of a simple terminal program, their computers will be running special bulletin board software. And their stations will generally be left switched on and available 24 hours a day. Packet radio is one of the few areas where unattended operation is allowed, even encouraged, by the regulatory authorities. A BBS operator can be in bed snoring away while his computer-controlled ham station does what it jolly well pleases!

The BBS which acts as YOUR post office is known as your HOME BBS. One of the first things you should do when you establish your new packet station is nominate a home BBS where you wish your mail to go. There will probably be several BBS's within your VHF range, any of which you could nominate. Probably the best way to choose is to listen around and see which ones other people are using. Make sure the BBS is easy to connect with, using low power if possible. That ensures a good strong signal will be getting there on higher power. If you are VK2ABC and your Home BBS is VK2XYZ, your packet address is then VK2ABC @ VK2XYZ.

When you first connect with a packet BBS, you can command it to list the text files it has available for reading. Some may be personal messages to you, others may be personal messages for other people, but some may be addressed to ALL. These are items deemed to be of interest to everybody, such as those rants and raves about regulation changes.

Some messages may be addressed to AMSAT. These are specifically for people involved in amateur satellite work, although anybody can read them. You may get hooked on satellites! Other messages may be addressed to ORBS or KEPS.

```
[8444] BN
Path: VK7ZTA
Date: 28 Jun 92 20:46:36 Z
From: VK7ZTA@VK7ZTA.TAS.AUS.OO
To: STS50@VK7ZTA
Subject: STS50 INFO freq.s visibilty chart
```

Due to modifications to antenna to fit into another window on the shuttle the bandwidth of the antenna used for 2mx activity has been affected which has caused a change in freqs as from 28/6/92. For ALL unsheduled activity this will be:

VOICE 145.550 simplex and for packet 145.090 simplex.

Activity on the sheduled freq are sheduled activity and your co-operation in not needlessly qrm'ing would be appreciated.

The following visibilty chart was generated from keps for day 179. A kep file will be found under the heading of STS50 NEW kepson vk7zta-1

		Satellite Schedule																							
Satellite: STS-50																									
Station: vk7zo																									
		Hour - EST																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
06/28/92																									
06/29/92																						*	*	*	*
06/30/92																						*	*	*	*
07/01/92																					*	*	*	*	*
07/02/92																					*	*	*	*	*
07/03/92																				*	*	*	*	*	*
07/04/92																				*	*	*	*	*	*
07/05/92																	*	*	*	*	*	*	*	*	*
07/06/92																	*	*	*	*	*	*	*	*	*
07/07/92																	*	*	*	*	*	*	*	*	*
07/08/92																	*	*	*	*	*	*	*	*	*
07/09/92																	*	*	*	*	*	*	*	*	*
07/10/92																*	*	*	*	*	*	*	*	*	*
07/11/92																*	*	*	*	*	*	*	*	*	*
07/12/92														*	*	*	*	*	*	*	*	*	*	*	*
07/13/92													*	*	*	*	*	*	*	*	*	*	*	*	*
07/14/92												*	*	*	*	*	*	*	*	*	*	*	*	*	*
07/15/92											*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

** [End Msg # 8444]

Fig.1: A print out of space shuttle orbit information received by Tom Moffat via his local packet radio bulletin board.

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These are sets of orbital parameters for weather satellites and others.

Instead of listing EVERY message it contains, you can command the packet BBS to list all its messages to a particular address. So if you're into weather satellites (see *EA*, June/July/August 1992), you can command it to 'LIST ORBS'. You will then see all the orbit files the BBS has available. Each message has a number and a date, so you can select the most recent, issue the command 'READ 8421' or whatever, and the message is displayed.

If, before you do this, you command your own computer to save incoming text to a disk file (i.e., 'WRITE ORBITS.TXT') you can capture the list of satellite orbital parameters on your disk. Later you can use a text editor to chop the address information off the top and then you can feed the remaining data file straight into your satellite tracking program — no typing required!

We keep harping away about Bulletin Boards, but there are many other interesting facets to packet radio. You can use it to connect 'live' with another station, and then you can sit there typing back-and-forth to each other, just like on radioteletype. This might seem mundane on VHF — using a microphone would be easier — but with packet you could be sitting in Melbourne typing with another station in Sydney, in theory at least. Your messages could be passed through a series of DIGIPEATERS, from one end to the other.

Once you are 'connected' to another station, you have what looks to both of you like a private line. Nobody can interrupt, and you don't get anybody else's traffic. But it is quite possible to have 'round table' rag-chew type conversations on packet, with nothing addressed to any particular station and everyone on the frequency able to read everything transmitted. Transmissions of this kind are known as UN-PROTO (without-protocol). To read them you must be in MONITOR MODE, which lets you see everything on the frequency even if it's not addressed to you.

Most packet software offers a monitor mode, which displays the address and control information as well as the data contents of each packet. This is the way to REALLY see what happens on packet (and to eavesdrop on other people's 'private' communications). From here on we will abandon those nicely formatted on-screen messages like in Fig. 1, enter Monitor Mode, and look at what goes on 'behind the scenes'.

Let's get technical!

Several things make packet radio stand out from all earlier methods of communication. Most important, perhaps, is that packet can be fully automatic. No operator need be present, except when launching or retrieving information from the system. Packet radio has strong error-correcting features, so information passed

```
1 T 12:23 VK7TM>VK7RR>SABM,P
2 R 12:23 VK7RR>VK7TM>A.F
3 R 12:23 VK7RR>VK7TM>I00,C.F0:
4 I'm not around now. Leave message in TNC
5 Please leave the path to get back to you
6 R 12:23 VK7RR>VK7TM>I10,P.F0:
7 000000
8 T 12:23 VK7TM>VK7RR>RR2,F
9 R 12:23 VK7RR>VK7TM>I20,P.F0:
10 Hello, be with you in a second.
11 T 12:23 VK7TM>VK7RR>RR3,F
12 R 12:23 VK7RR>VK7TM>I30,P.F0:
13 Hi Tom how are you today?
14 T 12:23 VK7TM>VK7RR>RR4,F
15 T 12:24 VK7TM>VK7RR>I04,C.F0:
16 Good thanks. We has snow here today.
17 R 12:24 VK7RR>VK7TM>RR1,R
18 R 12:24 VK7RR>VK7TM>I41,P.F0:
19 That's nice to know. Bye Bye for now.
20 T 12:24 VK7TM>VK7RR>RR5,F
21 R 12:24 VK7RR>VK7TM>RR1,P
22 T 12:25 VK7TM>VK7RR>RR5,F
23 R 12:25 VK7RR>VK7TM>DISC,P
24 T 12:25 VK7TM>VK7RR>DM,F

VK7RR connects with VK7TM

25 R 12:32 VK7RR>VK7TM>SABM,P
26 T 12:32 VK7TM>VK7RR>A.F
27 T 12:32 VK7TM>VK7RR>I00,C.F0:
28 BayCom V1.40 - POCKET PACKET modem
29 Toshiba T1200 laptop computer.
30 R 12:32 VK7RR>VK7TM>RR1,R
31 R 12:32 VK7RR>VK7TM>I01,P.F0:
32 Hello Tom. I am testing my TNC.
33 T 12:32 VK7TM>VK7RR>RR1,F
34 T 12:33 VK7TM>VK7RR>I11,C.F0:
35 Well it seems to be working OK now.
36 R 12:33 VK7RR>VK7TM>RR2,R
37 R 12:33 VK7RR>VK7TM>I12,P.F0:
38 Good. Bye for now...
39 T 12:33 VK7TM>VK7RR>RR2,F
40 R 12:33 VK7RR>VK7TM>DISC,P
41 T 12:33 VK7TM>VK7RR>DM,F
```

Fig.2: A blow by blow print out of a 'live' on-air packet radio session, made using the BayCom software's monitor mode.

through a packet system is — in theory at least — error-free. Probably the most interesting feature of packet radio is that many pairs of stations can work each other on the same frequency, with each pair appearing to have the channel on its own.

To illustrate, let's consider a cocktail party in a large room with people randomly scattered throughout it. The people are pretty shy; they only speak in short, broken sentences. And they only respond when called by name. Bill is standing against the east wall, and John is near the bar. Bill wants to send a message to John: "Hey John, it's Bill over here! Bring me a drink!" John responds: "John here, Bill — OK!"

Bill has sent a PACKET. He has unleashed a string of data consisting of a destination address (Hey John!), an

originating address (it's Bill over here!) and some information (Bring me a drink!). John, having received Bill's packet correctly, acknowledges with a packet of his own. It too has an originating address (John here), a destination address (Bill), and an acknowledgement symbol (OK!). Had John not got the message the first time, he would have said "Eh?" instead of "OK", and Bill would have repeated his original packet.

Meanwhile, other people in the room would have realised someone was talking, but they would have ignored what they heard because it wasn't addressed to them. Mary has noticed an old school friend, and when Bill and John finish talking she yells "Jane! It's me, Mary!". Mary has sent a special kind of packet, a CONNECT REQUEST. Her packet contained no data, only a destination address (Jane!), an originating address (It's me, Mary!), and an implication that she would like to converse (CONNECT).

As Jane and Mary rush toward each other, Bill is at it again: "Hey John, Bill here, make it a double!" Bill has sent a second INFORMATION PACKET: a destination address (Hey John), an originating address (Bill here) and some information (Make it a double!). Now 'Make it a double' on its own doesn't mean a lot, but when combined with the information from Bill's first packet it becomes clear that Bill is a tosspot: 'Bring me a drink! Make it a double!'.

So each INFORMATION PACKET is short and sweet, and not necessarily complete. It may take 10 or even 100 packets to tell the whole story. And other packets, connecting other people, may be sandwiched in between. Note that although many people are sharing the room, they must not speak simultaneously. If they do they will have a DATA COLLISION, and both their packets will have to be transmitted again, separately.

It is also important to note that once two stations are in conversation (connected), no third party is allowed to interrupt. If someone makes an attempt to break in, they'll get a packet saying, in effect, 'I'm busy! Go away!'. Bill and John would have heard Mary's outburst, but they would have ignored what she said because neither 'Bill' or 'John' was in her packet's ADDRESS FIELD. And Mary and Jane, now in deep conversation, would have ignored Bill and John.

Now let's change the setting, to a big ballroom. Many people are again scattered around, but now some are too far away from each other for direct bellowing. This is no problem, however, because we have placed a large table in the centre of the room, with Foghorn Sally standing

1 El proyecto DIGIMON es un proyecto en el cual participan un grupo de
2 radioaficionados argentinos y extranjeros que intentan diseñar, armar y
3 R 11:24 VK7BBS/VK7RTY*>VK7TM>I61,P,F0:
4 colocar un dispositivo digital de comunicaciones, de cierto modo parecido al
5 LUSAT-1, pero sobre la superficie lunar. De poder realizarse, pondra a la
6 argentina en el primer lugar mundial en cuanto a comunicaciones en general
7 se refiere.
8 T 11:24 VK7TM/VK7RTY>VK7BBS>RR7,F
9 R 11:24 VK7TM/VK7RTY*>VK7BBS>RR7,F
10 R 11:24 VK7RTI>ID>UI,R,F0:
11 VK7RTI/R
12 R 11:24 VK7BBS/VK7RTY*>VK7TM>RR1,P
13 T 11:24 VK7TM/VK7RTY>VK7BBS>RR7,F
14 R 11:24 VK7TM/VK7RTY*>VK7BBS>RR7,F
15 R 11:24 VK7BBS/VK7RTY*>VK7TM>I71,C,F0:
16 El instalar dicho dispositivo en la superficie lunar permitiria que las
17 estaciones de radioaficionados de todo el mundo puedan intercambiar mensajes
18 e información durante periodos de tiempo sumamente extensos, contrariamente
19 R 11:24 VK7BBS/VK7RTY*>VK7TM>I01,C,F0:
20 a lo que sucede con los microsatelites. Podemos decir que una comunicacion
21 entre Bombay (India) y Buenos Aires (Argentina) podria durar varias horas.
22 La NASA tiene un proyecto, llamado ARTEMIS, para el que pondran un
23 R 11:24 VK7BBS/VK7RTY*>VK7TM>I11,C,F0:
24 dispositivo sobre la superficie lunar en 1995/1996. Actualmente, siguiendo
25 una sugerencia de Walt (N3KVO), estamos tratando de contactar al director
26 del mencionado proyecto para ver si podriamos compartir el espacio en dicha
27 mision.
28 T 11:24 VK7TM/VK7RTY>VK7BBS>RR2,R
29 R 11:24 VK7ZGG/VK7RTY*>BEACON>UI,C,F0:
30 Next N.B. meeting will be on 8 July
31 VK7JJ, Phil will talk on aials he has built.
32 R 11:24 VK7ST>CQ>UI,C,F0:
33 Scott in Sandy Bay.
34 R 11:24 VK7BBS/VK7RTY*>VK7TM>RR1,P
35 T 11:24 VK7TM/VK7RTY>VK7BBS>RR2,F
36 R 11:24 VK7TM/VK7RTY*>VK7BBS>RR2,F
37 R 11:24 VK7BBS/VK7RTY*>VK7TM>I21,P,F0:
38 Para realizar este proyecto necesitamos apoyo economico, tecnico y la
39 posibilidad de efectuar pruebas de comportamiento termico de los componentes
40 en un lugar como CITEFA.
41 Quienes participan del proyecto:
42 LU1BOR Federico Ghiglione.
43 T 11:24 VK7TM/VK7RTY>VK7BBS>RR3,F
44 R 11:24 VK7TM/VK7RTY*>VK7BBS>RR3,F
45 R 11:24 VK7BBS/VK7RTY*>VK7TM>I31,C,F0:
46 LU1OOC Alberto Ibertis.
47 LU1DEC Edgardo Bonion.
48 LU2EDT Mario Ibertis Rivera, Editor de la revista LUSAT, publicacion de
49 AMSAT Argentina.
50 LU4AIW Eduardo Giacchino, Locutor y productor del programa radial "Radio
51 Encuentro" en radio El Mundo.
52 R 11:25 VK7BBS/VK7RTY*>VK7TM>I41,C,F0:
53 LU4DGN Carlos Farenga, Encargado del diseño de circuitos electronicos de
54 radio.

Fig.3: Another detailed analysis of a packet radio session, this time one which involves a 'digipeater' or digital repeater (VK7RTI). As you can see, the actual text message that is being transmitted happens to be in Spanish.

on top of it. She can hear everybody, and everybody can hear her.

George sees Fred way over on the other side of the room, and Fred has a problem. George must get a message through: 'Hey Sally, George here, tell Fred his fly is open!'. Sally throws back her shoulders and roars: 'Fred, it's Sally! George says your fly is open!'. Here two packets, containing the same information, were necessary to get through to Fred. The first went from George (originator) to Sally, with a request to pass it on to Fred (destination). The second packet went from Sally to Fred, with information that it came from George (originator).

Sally, up there on her table, is a DIGIPEATER. Her foghorn voice can be heard by everyone in the ballroom, even George who hears his own packet coming back at him. Note that Sally does not try

to transmit the message at the same time she's receiving it; she would simply be talking to herself. Instead Sally stores the entire incoming packet and then retransmits it. Sally's name has been included in each packet's ADDRESS FIELD, since she is now part of the transmission path.

Had Sally not been there, George could have asked anyone else in the room to relay his message, even though it might not have been as powerful. In packet radio, ANY station on the air can be used as a digipeater, even when connected with someone else. The operator usually doesn't even know this is happening.

In real life, packet radio is a written language only. And it's fast. On VHF channels packet is sent at 1200 baud, which works out at around 1200 words a minute — 20 times a reasonable

typing speed. Material being typed 'live to air' is stored on a computer screen until a whole line is full — about 80 characters. Then the computer blurts it out onto the airways with a mighty 'BBBRRRRRAAAPPPPP!!!'.

If you've ever listened on an amateur packet channel you'll know what I mean. One station goes 'BBRRRAAPP', another weaker one responds with 'BRAPP', then yet another goes 'BRRAAPPP'. It sounds a little like the 'baked beans' sequence from the film *Blazing Saddles*.

Each BRAAP is one packet, or 'frame', assembled according to the 'HDLC' or *High-level Data Link Control* standard. An HDLC frame (try pronouncing that acronym without breaking your jaw) is made up in the following way:

FLAGS | ADDRESS | CONTROL |
DATA | FCS | FLAGS

The Flags on the left are transmitted first, as synchronising pulses. 'Asynchronous' ASCII or Baudot (RTTY) transmission has a sync pulse at the start of each character. But packet is synchronous, meaning the transmitter and receiver must be running at exactly the same speed for correct decoding. The flags, which are repeating bit patterns of 01111110, get the receiver wound up to match the transmitter speed before valid data begins flowing. The flags make the 'BBRRRR' part of the 'BR RRAAPP' sound.

The address field is transmitted next, containing the originating address (George) followed by the destination address (Fred), with any waypoints (Sally) in between. The addresses in packet radio are actually amateur callsigns.

The control field specifies what kind of packet is being sent. We mentioned Connect Requests and Information Packets; there are others, which we'll look at soon by example. The data field contains the information we're actually sending (Your fly is open!). It can be anything up to 255 characters long.

The thing called FCS is a Frame Check Sequence — a checksum to verify that the entire packet is correct. If it's not correct, it is rejected and a re-send is called for (Eh?).

At the end of the packet are more flags. These may in fact join up with the beginning flags of the next packet, if a group of packets is to be sent in one burst.

The method of encoding the data bits is totally different from anything we've seen before in amateur radio. It's called 'non-return to zero inverted', or NRZI. This works on transitions; a signal transition from high to low or low to high produces a data '0' in NRZI. If no such transition

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occurs during a bit period, the result is a '1'. This system is used because a NRZI transition is guaranteed to happen at least once every five bit periods. This keeps the signal flipping up and down nicely so sync can be maintained, even when no flags are forthcoming.

One other piece of funny business: If, during the normal course of transmission, five '1' bits occur in a row, the system inserts an extra '0' and removes it again during reception. This process carries the elegant name of 'bit stuffing' and it ensures that no data sequence can ever resemble the flags, which are mostly strings of 1's.

The whole packet radio concept is centred on LAYERS. The lowest layer, or level, is called the *physical layer*. It is concerned with the actual communications — the modulation, the encoding and decoding of packets, and the synchronisation of the receiver with the transmitter. In many packet devices the job of 'packetising' is taken care of by a custom chip called an HDLC Controller. Other packet systems do the whole works in software.

The second layer is known as the *data link layer*. Its job is to make use of the address, control, and data sections of the packets from Layer One to set up a link, insert and remove the data within the packets, and maintain overall control of the link.

Layer three is concerned with working out routing information for packet messages. It can specify which links to use for which destinations, and perhaps produce a whole list of links to be used to get a series of packets from Tasmania to some destination in North Queensland. If you're just shooting packets around your part of the state with the local digipeater, you're doing Level 3's work. Level 3 really comes in to its own when you say 'Send this message to Perth'.

The operation of Layers 1 and 2 in amateur packet radio is governed by what's called the AX.25 protocol — which is a very, very detailed specification for what we've discussed in the previous few paragraphs. In many packet stations the Layer 1 and 2 functions are handled in an external 'black box' called a TNC (Terminal Node Controller) connected to the computer. In our Pocket Packet system these operations are carried out by the BayCom software in the IBM-PC itself.

All sorts of weird and wonderful schemes are being devised for the higher levels such as Kiss, NOS, and

SABM:	Set Asynchronous Balanced Mode. Tells the station at the other end that a "connect" is desired.
UA:	Unsequenced Acknowledgement. Returned by the distant station following a successful connect.
DISC:	Disconnect request. The link between the stations is terminated and both are available for other connects.
DM:	Disconnect Mode. Acknowledgement of a disconnect request. The station is now available to connect with someone else.
RRn:	Receive Ready. The previous packet has been received and the distant station is now ready for another one. The "n" is the number of the NEXT packet expected. Packet numbers increment from 0 to 7 and then start over again.
RNR:	Receive NOT Ready. The receiving station can not accept further data at the moment (its buffers are probably full).
REJ:	Packet rejected, probably because the packet number received was not the number expected. Retransmission requested.
FRMR:	Response to a packet with an unrecognized control code. Means the frame was probably mutilated in transmission.
Inn:	An Information packet. The two n's refer to the current frame number travelling in each direction.
P:	A "Polling" frame. A response is expected.
F:	A "Final" frame. A response is not expected.
C:	Appears to signify that another frame will be forthcoming before a response is expected. The last of these will have a "P". The "C" marker also seems to appear on beacons. No explanation in BayCom documentation, somewhat mysterious.
F0:	Purpose unknown, seems to occur with BayCom software only.
>:	Indicates that information is being passed from the left station to the right station, ie. VK2ABC>VK2XYZ. ">" after last station points to control codes.
/:	When a digipeater is used, shown after the station that originated the packet.
*	Shows that the digipeater is transmitting.

Fig.4: Here is a summary showing the meaning of many of the strange codes that you may have noticed in Figs.2 and 3. It isn't necessary to master all of this detail in order to get going in packet radio.

TCP/IP, but they're beyond the scope of this simple introductory article. (Whew! I got out of that one!) You'll learn about them soon enough when you start working with packet.

Now let's join hands and frolic through the address and data fields as we watch some real packet operations, as conducted by the BayCom software we'll be using with the Pocket Packet project. Fig.2 is a recording of a live on-air session. It uses BayCom's monitor mode, which displays packet address and control information as well as the data contents (which are indented).

To make explanation easier I have added line numbers. T means my station is transmitting, R means I am receiving. The time each packet was sent or received is shown, followed by the contents of the address field and then the control field. We begin with me, VK7TM, connecting with and passing traffic with station VK7RR across town.

At line 1, VK7TM sends to VK7RR, a 'SABM' or 'Set Asynchronous Balanced Mode'. This is the connect request. At line 2, VK7RR responds with a 'UA', or Unsequenced Acknowledgement. This verifies we are now connected. At line 3 VK7RR sends his first information packet, the data of which is the indented text in lines 4 and 5. Looks like we've struck his damn answering machine!

At line 6, maybe there's somebody there after all. VK7RR's computer has sent six ASCII nulls (zeros), for reasons neither of us can fathom, and I acknowledge the packet at line 8 with an 'RR' (Receive Ready, which implies that I must have received the previous packet OK; otherwise I wouldn't be ready for more). At lines 9/10 VK7RR sends another information packet — he is there after all — and I acknowledge at line 11.

He sends another info packet at lines 12/13, 'Hi Tom...'. He knows who has called, because as soon as the connect se-

quence was completed his terminal said something like '***Connected with VK7TM'. At line 14 I acknowledge receipt, and then send an info packet of my own: 'Good thanks...'. He acknowledges, and then sends an info packet: 'That's nice to know...'

At line 20, I acknowledge. At line 21 VK7RR sends off a Receive Ready packet. I think his computer is waiting for me to say something. At line 22 I acknowledge his Receive Ready with my own Receive Ready (nobody said packet was smart — just automatic!).

At line 23 VK7RR has had enough and sends DISC, a Disconnect Request. I respond by going into DM, Disconnect Mode. I am now ready for a connect request from another station.

Now let's see what happens when VK7RR connects with VK7TM, the other way around. At line 25 he sends an SABM connect request. I respond. Then I send what's called my CTEXT, a message that goes out to anyone who connects with me. Many people use this to briefly describe their station, as in lines 28 and 29.

The first info frame from VK7RR says he is just testing. I acknowledge at line 33, and then send him an info packet at lines 34/35. VK7RR says goodbye, I acknowledge, he sends a DISC, and I go into Disconnect Mode. All is quiet on the home front again.

Going deeper...

Now to get into the heavy stuff, involving several stations in two different cities. Fig.3 shows a text file (the one about the repeater on the moon) coming from VK7BBS in Launceston via a digipeater to me, VK7TM.

VK7BBS is the major GATEWAY into Tasmania with both HF and VHF packet facilities. I am a MEMBER of VK7BBS, although it is not my Home BBS. That is in Hobart.

VK7RTY is the digipeater at Mt. Barrow, 160km from Hobart. This is the only repeater involved; we are making the full distance all in one hop, so signals are a bit shonky, but the Pocket Packet modem is demodulating them clearly. VK7RIT is the digipeater on Mt. Wellington at Hobart.

VK7ZGG is a packet station in Launceston, VK7ST is a packet station in Hobart. The display uses the same conditions as in Fig.1, except that this time the data in the packets is in Spanish so we can recognize it easier.

Fig.3 picks up the file transmission already in progress, and I acknowledge receipt so far at line 8. At line 9 we see the digipeater repeating my acknow-

ledgement to VK7BBS. An asterisk (*) appears next to a digipeater's callsign when it is transmitting.

At this point, at lines 10/11, the Hobart digipeater emits an ID. It does this from time to time, just to remind everyone that it's there. It was not involved in this particular operation — maybe it was feeling left out.

At line 12 VK7BBS sends a 'poll' frame via VK7RTY, apparently asking if I'm still there. At line 13 my terminal says 'Shore 'nuff, let 'er rip', and at line 14 VK7RTY relays that to VK7BBS.

Now VK7BBS gets brave, and lets off three packets in a row, with each packet pretty well chock-a-block with Spanish data. One frame normally holds a maximum of 255 characters. At line 28 my system acknowledges them.

Again the file transmission is interrupted by a beacon, this time from Launceston, relayed by VK7RTY. A beacon like this can have a text message attached to it, in this case advice of the next meeting of the Northern Branch of the Tasmanian WIA. After that another beacon, VK7ST, goes off in Hobart.

With the beacons now quiet, VK7BBS resumes transmission of the file. It arrives at VK7TM complete and intact, with no errors. Note that the interruptions from the various beacons were quite legitimate; that's what they're designed to do.

Had some other station chosen to connect with VK7ZGG or VK7ST, that would have been fine, and VK7BBS would have kept slotting packets of the Spanish text file in between packets from the other stations. As for them, they would never have known VK7BBS was transmitting something to me at the same time, unless they went into their MONITOR modes where they could see everything.

If you look at the time displayed with each packet, you'll see that everything in Fig.3 took place within a space of one minute — fast and furious!

If you multiply that activity by every city in Australia, and every country in the world, you'll see that packet radio is here in a big way. Once you join the packet crowd you'll find there's discussion and information on all kinds of sophisticated networking systems, and you'll see that what you've read here is just scratching the surface.

Next month we present the construction article for the Pocket Packet modem, along with a detailed discussion of the BayCom software needed to get it going. We may also look at a similar package called 'SP', which has taken me a while to get going because all the documentation is in German.

The kit

If you're eager to get started, you can order your Pocket Packet modem kit right now from High Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7054.

As mentioned above, the modem plugs straight into an IBM-compatible computer's serial port, and it draws its (tiny) operating power from the computer. The kit is based on a special integrated circuit costing around \$50.00. The chip contains a complete 1200 baud modem, and it's worth the high price because its performance is absolutely first class and it allows a fairly simple kit design.

The kit consists of a small PCB (which MUST be used for successful operation), the modem chip, a special crystal, and all the other parts needed to make the kit go. All you need to supply are a few bits of cable and whatever connectors are needed to hook the modem to your radio — plus a small mini-box to house it in.

Also included is a disk containing full kit assembly and set-up instructions, and some software specially written to provide power for the kit and test signals for receiver balance and transmitter level setting.

As a special introductory offer, the price of the kit posted anywhere in Australia or New Zealand, is \$79.50. At present I can only guarantee this price for the first batch of kits, as the cost and availability of some of the parts is rather variable, and I may have to pay more and charge more for later batches. Send money orders or cheques only please, in Australian dollars. We do not have credit card facilities yet — maybe next year, if things keep going well.

As a courtesy to EA readers, we will also include a copy of the BayCom packet software, version 1.4E, to fill out the space on the disk. This is a freely distributable Shareware version of BayCom, which I collected from a telephone BBS system at the University of Southern California. Other BayCom versions are floating around on Australian telephone and packet bulletin boards, and you can certainly use one of these if you prefer.

You, the user, are expected to pay for the software by an appropriate donation to the BayCom team in England. I'm sure once you see BayCom working you will have no hesitation with your generosity. By the way, please specify with your order whether you want the software on a 3.5" or 5.25" floppy.

By the time you read this, we should also be able to offer the SP package as an alternative to BayCom, if you prefer. Just tell me which one you want.

See you next month!

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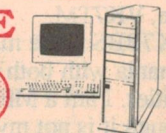
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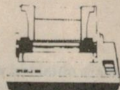
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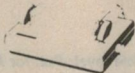
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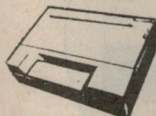
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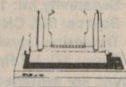
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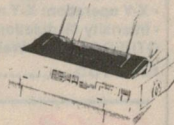
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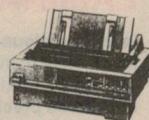
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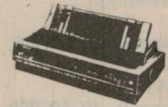
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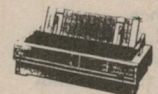
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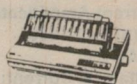
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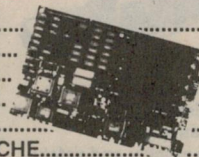
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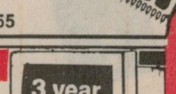
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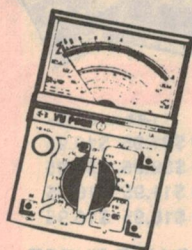
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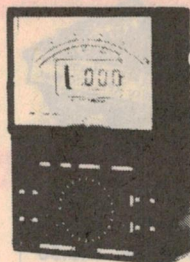
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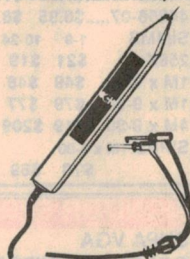
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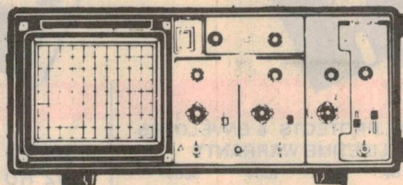


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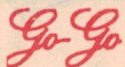
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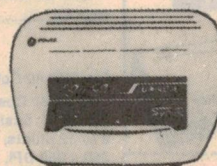
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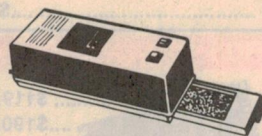
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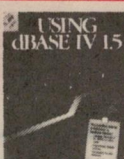


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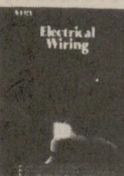


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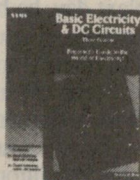


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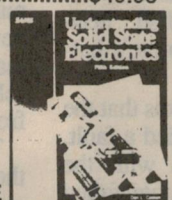


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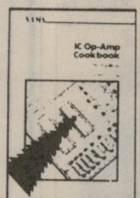


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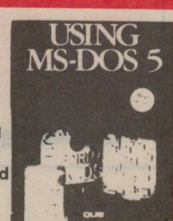


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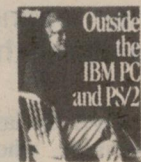


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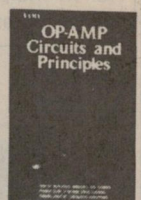


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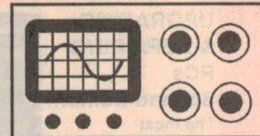
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THE SERVICEMAN



Brain surgery on an Akai — which was not entirely successful

I have three interesting stories for you this month, two from a local colleague and another from my own bench that involved an Akai VCR with persistent amnesia. This one really took me to the hair-tearing stage, because as well as needing 'brain surgery' it also proved to have a backup battery problem that I never quite solved...

Over the last couple of weeks a friend of mine, who answers to the name of Frank, has shown me two very interesting television faults. Unfortunately he was unable to tell me very much about how he tracked down the cause, at least in the first story. But the symptoms are sufficiently unusual to make it worthwhile for me to tell you all I know about them.

The first one was an AWA C3421, a model that features a fully configured remote control. It was the remote control that created the most confusion with the fault, since the set had been working perfectly until the remote's batteries went flat.

It came about this way. It seems that the owner had no idea the set carried a fault, since he usually operated it with the remote control. When the remote failed one night, he found that he could only

select some of the channels with the main front panel control buttons.

Specifically, only the *even numbered* program channels could be selected. The odd numbered buttons were totally inoperative. If channel 2 was playing on program 2, then pressing 1 or 3 left channel 2 on screen, without the slightest flicker to suggest that the odd numbered button was doing something.

The owner overcame the immediate problem by re-tuning the channel he wanted to watch onto one of the even numbered buttons. Next day, he bought a new battery for the remote control. With that, the set reverted to normal operation, selecting odd or even program numbers from the remote without hesitation.

The owner had no idea about how long the set had been in this condition but he realised it had a fault, so brought it to Frank for attention.

The unfortunate thing with this story is that I can't tell you how Frank went about finding the problem. All I know is that it turned out to be the control microprocessor, an M490B1 microprocessor chip. Replacing this cured the fault and the set would then select odd or even numbered programmes, from either the front panel or the remote control.

I don't have a circuit description for this chassis, so I can't be sure about how the control microprocessor is arranged. However, the circuit diagram shows that there are two 'common' lines from the keyboard scanning matrix. One line returns all the even numbered buttons, and the other returns the odd buttons.

What seems to have happened is that the return from the odd line had failed, *inside* the chip. Careful checks showed that there was nothing wrong with the line from the front panel buttons, right up to the relevant pins on the chip.

The decoder inside the chip was ap-

parently unaffected, since the remote control signal, which enters the chip on an entirely separate pin, was able to select any program without a hitch. So it seems that the failure was in the link between the pin and the decoder, inside the chip itself.

In a way, this story is most disturbing since microprocessor faults are difficult enough to diagnose at any time. This kind of 'partial' breakdown could have one going round in circles for ever.

It might be tolerable if replacement micro's were available 'at the corner store'. But in television sets (and videos) every microprocessor is different and even one manufacturer might use a dozen different chips. It doesn't help us or the customer to have to wait while a spare part is ordered from a distant maker's local supplier.

No-fault problem!

The second story from the same source concerns an Akai television, a model CT-K209. Fortunately, this one didn't need any spare parts. In fact, it was a 'fault that wasn't a fault'.

The set had no sign of a picture — just a blank gray screen. However, the sound was quite normal, proving that the front end and IF sections were working properly.

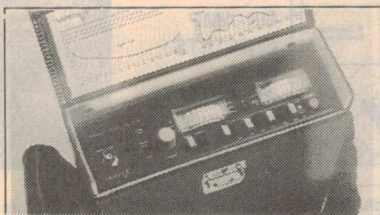
An oscilloscope examination showed that the video detector was working, and there was video available at the input to the chroma decoder, IC501.

It was while Frank was looking around this chip with the scope that the picture suddenly returned, but without a trace of colour. He got a similar result when checking voltages on the same pin.

Reference to the circuit diagram suggested that he was doing something to the subcarrier oscillator and he soon found that in fact, his probing was killing the 4.43MHz subcarrier signal. This ac-

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counted for the 'no colour' situation, but was no explanation as to why the picture returned when the oscillator stopped.

The only thing he could think of was that the oscillator was off frequency, but a check with a frequency counter soon put that theory away.

All the voltages around the chip were as near normal as could be expected, and even replacing the chip made not the slightest difference.

After several frustrating hours of testing and measuring, he reached the verdict that there was nothing wrong with the components anywhere around the circuit. The only possibility was one of maladjustment, so he started to fiddle.

Most of us reach the stage of fiddling when we can't find a reason for a fault. Some fiddle earlier than others and some fiddle without any plan or direction. Frank was none of these; he only fiddles when all else fails, and then only to a carefully considered plan.

The plan consists of using a fine felt pen to mark the original setting of each available adjustment. This is so that the control can be returned to its original position if adjustment proves ineffectual.

Then, taking one control at a time, he tweaks it by a small amount clockwise and checks any voltages and waveforms that might be affected by that control.

If clockwise rotation produces no result, he will return to the original position, then begin a similar series of tests in the anticlockwise direction.

If 45° either way produces no result, he will restore that control to its original position then go on to another.

In this particular chassis there are very few mechanical adjusters. Most functions have built-in automatic controls. So he didn't have to work for very long before the picture returned in full and glorious colour.

It appears that the last adjustment he made was to the chroma delay line 'matrix adj' pot VR501. This had been slightly out of balance, apparently by enough to remove all trace of colour.

But it doesn't explain how it could also remove all traces of luminance!

This 'fault that wasn't a fault' was completely repeatable. Restoring the adjustment to its original position once again removed both luminance and chroma — a slight tweak clockwise and both were back.

Quite obviously, it was something in the chroma processing chip that was blanking the video. But whether this is normal for that chip or a one-off aberration, we don't know. It would be interesting to hear if anyone else can repeat the

'fault' by tweaking VR501 in a different CT-K209...

The Akai VCR

The next story this month comes from my own workshop. It turned up at a most opportune time, since I had just finished work on another story, about servicing digital equipment.

To complete that story, I had to do a lot of study and revision about digital circuits, and what I learned (or re-learned) stood me in good stead with this job.

The story involves another Akai product, a model VS-4E VCR, and it went like this. The recorder arrived with a note, saying that the picture was 'all streaky'.

When I got it fired up, it was showing a classical case of 'one dirty head'. I could see the general outline of my test tape on the monitor, but it was overlaid with hundreds of short white noise streaks. Clearly, what had happened was that one head had picked up a scrap of muck and had been unable to wipe it off on the tape.

It took only a moment to clean the heads, and while I was on the job I gave the rest of the tape path a good going over as well. The next time I pressed PLAY the machine responded with a first class picture, with no sign of the dreaded streaks.

As a matter of course, I put a blank tape

in the machine, to test the record function. A lot of people never record anything on their VCR's, but it would be my luck to return a faulty machine to one of the many who *do* use it for time shifting!

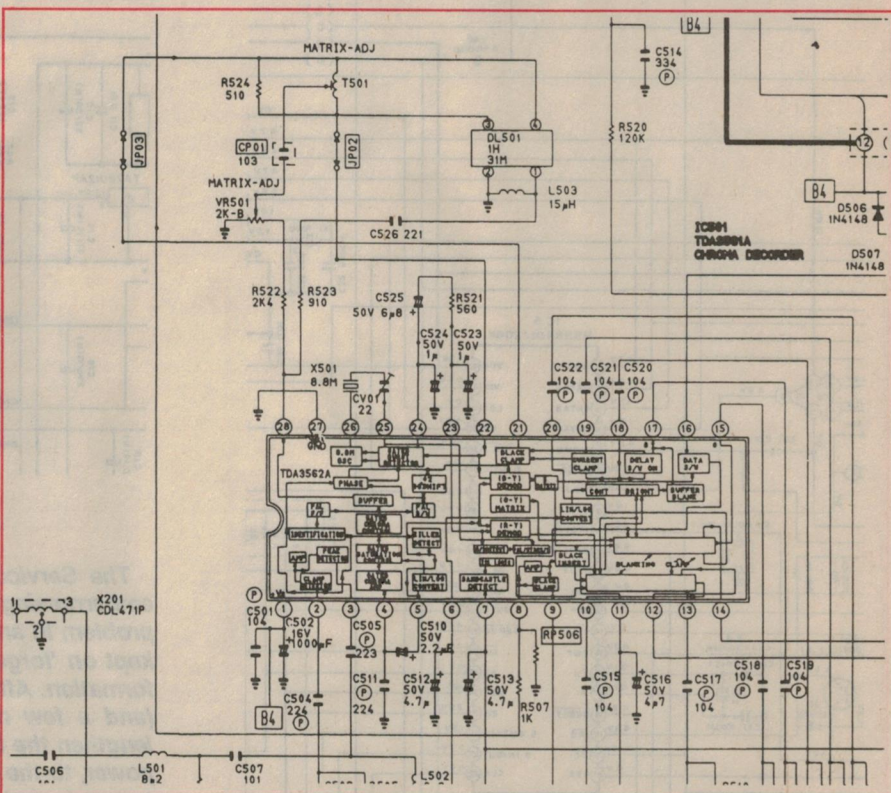
I'd had no reason to suspect that the machine would not record, but this one could not record — because there was no sign of an EE signal from any of the local channels. It looked as if the memories needed programming, for the local channels.

Like other early Akai models, this one used a complicated system of on-screen instructions and multipurpose buttons to perform virtually any function called for.

Setting up the channels is a most time-consuming and frustrating procedure. One presses button A to select the PS (whatever that means — presumably 'program selector') to which you wish to tune a channel.

Then pressing button B starts a long, slow trudge, through first the UHF and then the VHF channels. If you want a channel at the high end of the VHF band, it can take all night. Having found the channel you want, you then press button C to memorise the setting.

There's nothing on the screen or front panel to show how to remove the on-screen instructions, which will persist for a week if not cancelled. So one is tempted



THE SERVICEMAN

to press button D, marked 'PS Cancel' — except that this wipes the PS you have just so laboriously set, and you have to start all over again!

I dare say that there is an easier way to do this job. Or perhaps the legend on the front panel would have made more sense if I'd had the user manual. Still and all, I'd do nasty things to the designer of this system if I could ever get my hands on him...

Eventually I got all the channels tuned in and made my test recording, which came out quite satisfactorily. Fortunately the on-screen rigmarole didn't record on tape, although it did make EE viewing rather tedious.

(I did find out later that you can have the search move backward by pressing and holding down the lefthand end of button B. This helps speed up the setting of some channels, but 2 is still the same distance from 28, no matter which way you go! And there IS a way to remove the on-screen instructions, but it's not at all obvious!)

At this point it was knock-off time, so I switched everything off and went home.

Gone again...

Next morning, I powered up the machine for a last test before putting it on the shelf to await its owner. Except that this time, there again wasn't any channel to be seen. The so-and-so machine had forgotten everything I had so laboriously taught it the day before!

This is not such an uncommon experience with these machines. The tuning information is stored in a battery-backed ROM and when the battery fails, so does the memory. As these sets are now about 10 years old, battery failure is reasonably common.

In fact, most of the time this is the only reason that I see these models. Other electrical and mechanical faults are relatively rare.

So the battery was the first thing I went for. It could have been a dead battery, or just a flat one. Sometimes the float charging circuit dies and lets the battery down. More often, though, it's a worn out cell or cells.

In this case there was no sign of a faulty or discharged battery. It was a full bottle and in excellent order...

The memory is contained in the system control microprocessor IC5, and is kept

alive by a voltage applied to pin 41 on the chip. This is nominally 4.9 volts while the set is connected to the AC mains, and drops to something over three volts when the power fails or is disconnected for any reason.

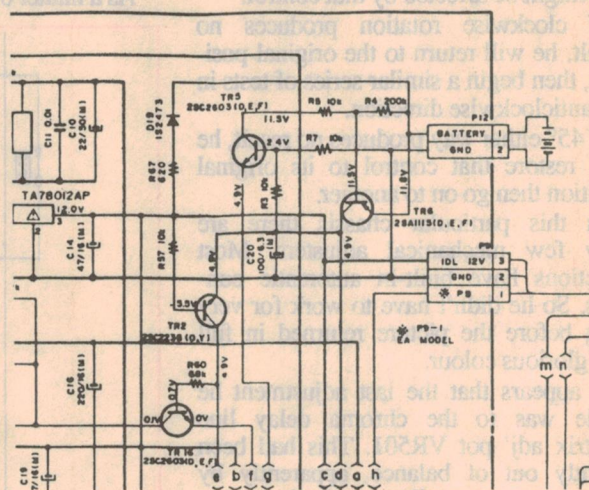
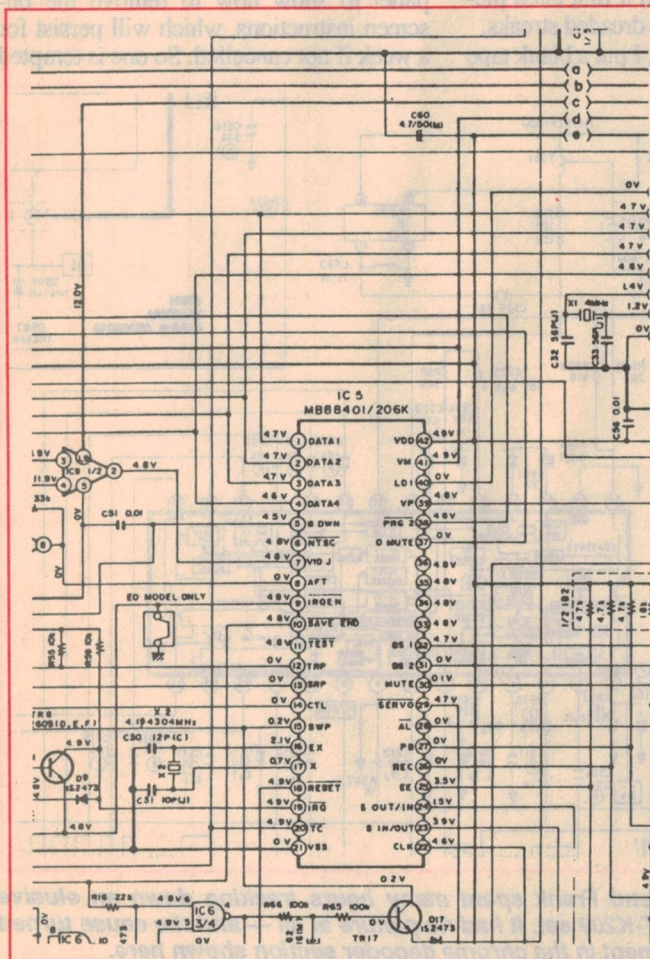
The backup battery consists of three NiCad cells, which should deliver 3.6 volts. In good order and fully charged, the battery delivers more like 4.0 volts and this is fed to the memory through a transistor switch TR6.

In this machine there was a steady 4V on pin 41 with the power on, and 3.5V with the power off. So it didn't look like a backup supply problem that was causing the loss of memory. With this discovery, I was in trouble — since I don't know very much about microprocessors and their internal workings.

Yet I was also a bit lucky, because the service manual includes several pages of block diagrams for all the IC's in the set, including a very detailed one for the syscon micro.

In addition to the diagram, there was also a list of pin assignments and a quaint 'Japlish' explanation of what each pin does.

Reading through the list, I found that



The Serviceman himself also had to spend an embarrassing amount of time tracking down a problem in an Akai VS-4E video recorder — which kept on 'forgetting' its channel memory tuning information. After replacing many likely components (and a few not so likely ones), he managed to lengthen the time it would remember them without power, to the point where the owner was prepared to use it again. However he never did discover the real cause of the trouble!

there were two pins relevant to my problem. Pin 18 was marked RESET, and pin 20, marked TC, was concerned with detecting a power-down condition. Both of these pins were normally at 4.9V, or logic high, and both should go to logic low at power down.

It seems that the object of the RESET is to dump the micro's memory settings into RAM at the moment of power-down. I might be wrong, but as I interpret the instructions, the settings are not put into RAM until a power-down has been detected. Which means it has to be done in a hurry, if data is not to be lost before the last drops of power flow from the power supply!

My problem was to determine if the TC and RESET pulses were occurring, and at the right times.

What I really wanted was a digital storage oscilloscope, at three or four thousand dollars. What I finally settled for was a digital logic probe, at \$25.

With the logic probe, I was able to determine that both pins received a healthy LOW pulse just before the power failed completely. And since there was always more than the requisite 3V on the VM pin 41, the loss of memory could only be due to a faulty micro-processor chip.

The syscon micro in this machine is an MB88401/206K (or M). (There is another MB88401 in the machine, on the operations PCB, but this has a different suffix.) I was able to borrow one from a colleague and soon, after a short piece of delicate brain surgery, had the new chip in place.

At switch on, I set about the tedious task of reloading the station information back in, and then checked out every function on the front panel. All was normal; so I switched off, checked that the memory voltage was still present, then went off to lunch.

An hour or so later, I switched the machine on again, and there were all the stations, exactly where I had left them — whew!

This was all I needed to confirm my diagnosis of a faulty chip. I had been quite edgy until then, because the chip is expensive and to replace it by mistake is not conducive to a healthy bank account.

I went through the same routine several times that afternoon, and each time the memory remained fixed. So I called the owner and offered him the choice of the good news or the bad news.

It was only then that I learned that the set had suffered from the loss of memory for some time. They were in the habit of moving the machine to another part of the house every couple of days, and each time they had to reset the channels.

Fault of the Month

Sharp VCR, Model VC583X and probably others

SYMPTOM: Goes into fast forward mode soon after the Play button is pressed. This is usual with unrecorded tapes, but in this case it persists even with known good tapes.

CURE: Clean the video heads. In this system, the machine interprets lack of coherent video as an unrecorded tape and so goes into 'search' mode, to look for a useable signal.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

They found retuning the channels just as tedious as I did, but elected not to have the matter fixed until some other more dramatic fault had to be attended to. The only trouble was, they forgot to tell me about the memory problem and if I hadn't run a full test on the set, they would have got it back, untreated.

As it happened, they were pleased that I had found and fixed the problem, and were quite happy to pay a bill considerably bigger than they had anticipated.

Oh — no!

The owner was to call next day to pick up the machine, so that morning I set it up so that I could demonstrate that the memory faulty was indeed cured. Except that it wasn't — there was no sign of an off-air signal!

Once again I checked the memory voltage and found it normal. I checked the reset and detector pulses; again normal. I turned the power off for several minutes and the channels were there when I refired the set. I left the power off for two hours, and still the channels came up properly tuned and in their right places.

With a certain amount of frustration evident(!), I rang the owner and told him not to come back until next week. Then I set about finding out what was happening.

Over the next few days I tried switching the set off for longer and longer periods, and eventually found that the memory was retained for about three to four hours, and was then lost.

It didn't seem to be the battery, and every time I checked the memory voltage it seemed to be spot on and steady.

The only excuse I could think of was that somehow the memory voltage was being momentarily interrupted. This would explain why the memory was lost, but the voltage always appeared to be present.

Eventually, I began to wonder if it really was a momentary interruption to the memory voltage.

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THE SERVICEMAN

I realised that I was checking only after I had re-applied power. I asked myself if the memory voltage was there BEFORE I restored the power?

There was only one way to find out. I put the machine on the shelf and left it until the next morning. On past experience, I could be sure that the memory had been lost by then.

When I checked next morning, there was no voltage on pin 41. This explained why the memory was lost — but not how. It seemed as though I was to be called on to perform vascular surgery on this machine, as well as brain surgery!

I tried the battery and it was up to full charge. I checked plug P12, which admitted the battery voltage to the board. That was OK. Next I checked the emitter of TR6, and found about 3.9V. Similarly, the base of the transistor had the same voltage on it. Yet on the collector there was nothing. Clearly the transistor was turned off. But why?

An in-circuit check showed no anomalies in its behaviour. Both junctions appeared to be OK, but the transistor was not passing any current.

I switched on the power and the transistor immediately came good. The collector voltage rose to just over four volts and base emitter voltage settled at 0.6V. It was now, by every test, a perfect transistor and remained so even when I turned the power off again.

Over the next few hours I monitored the memory voltage and it remained perfectly stable. Then about four hours later, it suddenly wasn't there!

Restoring the power also restored the transistor. And as I couldn't find any other component that could cause the trouble, I had to accept that the transistor was playing up. So I changed it.

But all to no avail. Three of four hours later, the memory voltage again disappeared. The backup battery was still fully charged, but there was no sign of voltage on the collector side of TR6.

I pored over the circuit diagram for an hour, trying to spot anything that could switch the transistor off. The only thing I could think of was an electrolytic capacitor C20, which bypasses VM to ground. If this was leaky or intermittent short circuit, it could drop the voltage. But replacing the capacitor didn't cure the trouble either.

I sought the help of several colleagues, who have more experience with these Akai's than I do. One of them had a good knowledge of this particular part of the circuit and suggested that I look at TR5, part of the circuit which keeps TR6 turned on. As he explained it, TR5 and TR6 are normally off, with battery charging current supplied through R67 and D19. At the moment of power down, the charge on C20, provides base current to turn on TR5, which in turn allows base current for TR6 to flow via R4 and R5.

With TR6 turned on, the requisite 3V is supplied to pin 41 on the microprocessor. Or at least, that is what is supposed to happen.

I had worried about TR6 being faulty and had changed it. But clearly TR5 was equally critical, so changing that was just as likely to cure the fault.

But it didn't.

By this time I was ready to give up in disgust. I had half-cured the trouble and the owner was becoming impatient. I put the situation to him.

I had taught the machine to remember where the stations were, and that was more than he had hoped for when he brought it to me. What's more, it could remember for a couple of hours or more, enough to cover the most likely power outage.

Continued on page 98

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They have competitions for solar-powered cars, so it's fitting for an electronics magazine to do something similar. Here's how you can win one of the 25 great prizes, provided by Oatley Electronics and worth over \$5000 total!

We are looking for applications that are based around solar power. Ideally, your application should be electronic, although we're open to all kinds of ideas.

Perhaps you've developed a method of directly powering a motor with solar energy, or a way of tracking the sun so a solar panel is always exposed to the best sunlight. Maybe you have proven ideas on how to maximise the energy from a solar panel.

Whatever your idea, if it uses a solar cell, why not enter and possibly win a prize. The most original and ingenious idea/project will win, although there are lots of prizes, so at least 25 people stand to win something.

There are five major prizes and 20 runner-up prizes. Here's what you can win:

First prize:

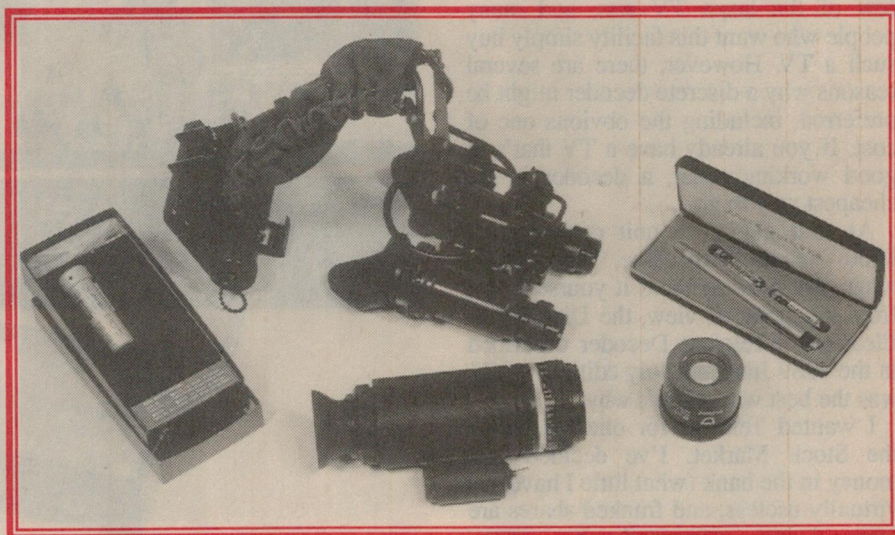
A second generation night viewer. Custom made viewer that uses an ex-military 'second generation' image intensifier tube. It can operate in starlight conditions (almost full darkness), but produces amazing images if the targetted area is lit with low power infrared (IR) light. (Value \$1800)

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Third prize:

An image intensifier tube. A second generation image intensifier tube with built-in electronics. Requires a 3V battery, a lens and an eyepiece to make a complete IR viewer. (Value \$600)



Fourth prize:

A laser gun sight. A US made 5mW laser gun sight complete with a rifle mount. (Value \$399)

Fifth prize:

A laser diode pointer — a pen-sized 5mW visible diode pointer in presentation case. (Value \$199).

Prizes 6 to 15:

Solar panels. Each of these winners will receive 10, 6V/1W solar cells — enough to make a 10W solar panel. Value of each prize is \$85. (Total value \$850).

Prizes 16 to 25:

Electronic Keys. Each winner will receive a complete kit of parts for the Electronic Key project described in July 1992. The kit includes two keys and one receiver. Value of each prize is \$59. (Total value \$590).

Total prize value is over \$5000 — so why not enter, even if your application seems simple

to you. It may win one of the 25 prizes!

Entries will be judged on their usefulness, originality and general appeal to other readers. All diagrams and written descriptions in your entry should be presented clearly. Ideally you will have proven your application and supplied sufficient information to allow us to publish details.

To enter, send your entry to:

Solar Competition
Electronics Australia
PO Box 199
Alexandria
NSW 2015

Note that this competition closes 31st January 1993. All winners will be advised by mail and results will be published in the April 1993 issue.

All prizes have been donated by Oatley Electronics,
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Phone (02) 579 4985

Enhancing DSE's Teletext Decoder

If you have built, or plan to build the Dick Smith Electronics teletext decoder, here's details of a few little modifications that enhance the unit, making a great project even better.

by PETER PHILLIPS

Teletext is now available in quite a few of the latest TV sets, and many people who want this facility simply buy such a TV. However, there are several reasons why a discrete decoder might be preferred, including the obvious one of cost. If you already have a TV that's in good working order, a decoder is the cheapest way to go.

At first glance, a unit costing over \$400 seems expensive, particularly when you need to build it yourself. But from my point of view, the Dick Smith Electronics Teletext Decoder described in the 1989 June and July editions of *EA* was the best way. Here's why...

I wanted Teletext for one reason — the Stock Market. I've decided that money in the bank (what little I have!) is virtually useless, and franked shares are now being promoted by many economists as the best method of gaining a tax-free income. As well, options trading is becoming more popular, with small but regular profits possible if you know what you're doing. However the key is knowing what is happening on the stock market.

I discovered recently that half-hourly reports of all traded stocks are given in the Channel 7 Teletext transmission. You get the current price of the stock (if it has traded) and the direction of the price movement. As well, there is a wealth of other information, including suggestions from stock brokers and others 'in the know'.

Although it's possible to gain this information in daily newspapers, it will be up to 12 hours old by the time you get it. The cost of getting the data from vendors of the information varies, (around \$40 a month and more) and you don't get all shares unless you pay for it.

And best of all, my accountant has assured me that I can claim the cost of the Teletext decoder on my tax, assuming I have an income from the stock market. (Don't quote me however, as I haven't got that information directly from the tax office!)



The relay switching unit fits into a jiffy box that connects to the rear of the decoder. All plugs and sockets use RCA type connectors and all leads should be as short as possible. Note the earth connection from the metal lid to the case of the decoder.

Another compelling reason for a separate decoder was the need to have the unit connected to a TV other than that used by the family. The quickest way to get a rebellion in my place is to interrupt the TV entertainment, and Dad looking up share prices does not constitute entertainment.

I also wanted the system near my computer so I could update the spreadsheet detailing my forays into the market. So given the possible tax concession, the fact that it had to be near the computer and connected to a basic colour TV led me to a discrete Teletext decoder unit.

These days there are not many ready-built decoders available, so the Dick Smith Electronics kit seemed the best way.

Despite my association with the magazine, there are no friends in business, so I simply went to the nearest

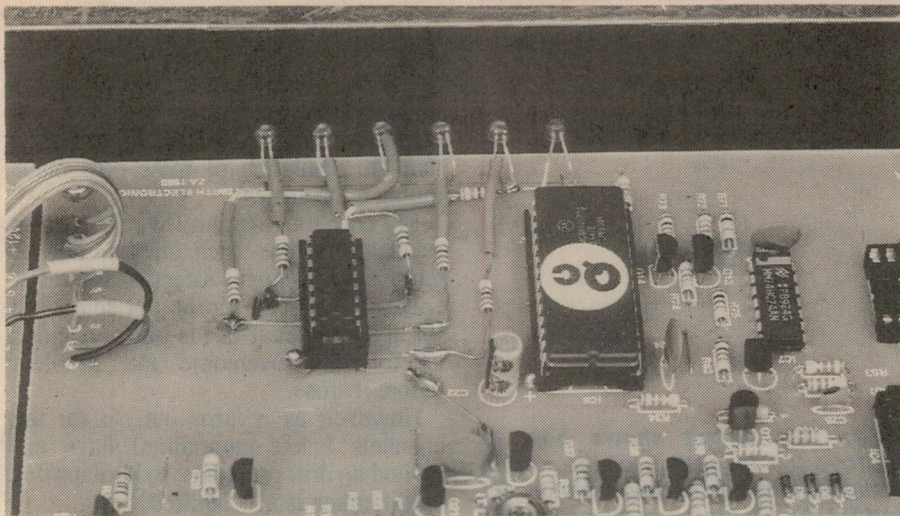
Dick Smith Electronics outlet and purchased the decoder and the separate tuner kit. Then it was back home to build it.

Putting it together

I started with the remote control unit, which went together easily enough, without any problems. Like anyone else, I simply followed the original *EA* article describing the construction (supplied with the kit).

Building the decoder is also relatively straightforward, although it takes a bit of time. The only error I found is that C58 is a polyester type, rather than a ceramic type as described in the component list.

Also, although not really an error, the mounting holes for L4 (4.7mH choke) are spaced rather closely, while those for L3 (15uH choke) are wider than they need to be. Initially I thought the layout diagram was wrong, as reversing these



This photo shows how the six channel indicator LEDs and their drive circuitry are fitted to the decoder PCB. The IC to operate the LEDs is fitted via a wire-wrap IC socket, with holes drilled in the PCB for those leads that connect directly to the existing tracks.

coils gives the correct hole spacing. But not so.

Another minor point is that the holes for the three preset pots need to be enlarged. As well, I decided to add heat-sinks to the three-terminal regulators, as the brass pillars supplied in the kit seemed to be a bit 'light-on' for heat-sinking purposes. The regulators still run slightly warmer than I'd like, so I recommend using heatsinks — such as a piece of aluminium formed to fit the available space and mounted between the regulator and the PCB.

Once finished, I decided to test the decoder before constructing the tuner

section — by connecting it to the output of a VCR. I wasn't amused when the unit didn't work.

Naturally I laid the blame on the project designers, as I'd taken extreme care in the construction! However it turned out I'd accidentally soldered two points together on the PCB, and removing the bridge solved the problem.

From then on, the unit worked and simply required the tuning adjustments described in the article.

The tuner module

Next came the tuner module. Here I discovered that DSE have had to make a modification, as the original tuning potentiometer-band switch units are no longer available. Instead, separate band switches are supplied, which connect to a modified PCB design.

I decided to hard wire the required bands, rather than go to all the fuss of adding the switches. After all, once set it's unlikely they'll need to be changed. The new PCB design allows the hard wiring to be added quite easily using wire links.

Again I made another construction error, by mounting the IF module upside down. As the photos in the article supplied with the kit clearly show, the adjustment holes in the IF module face the PCB, rather than being accessible. I assumed these would face up, and proceeded to wire the unit accordingly. Fortunately no damage occurred, although the 12V rail was shorted to earth by the module.

Fixing this error brought everything to life, and finally I was 'on the air'. However, after a few hours playing with the

unit, I decided a few modifications were in order. While the unit was working well, and exactly as described, there were a few extras that seemed easy enough to add.

The first of these was a channel indicator. Although there is only one Teletext channel (ignoring those that transmit subtitles), I felt I was flying blind without some form of channel indicator.

Channel indication

I figured out three different ways to add a channel indicator, but finally decided to add a row of six LEDs to the front panel. The other two ways are interesting and perfectly viable, except they require more effort.

The first way is to buffer the tuning voltage with an op amp and to fit a small voltmeter to the front panel of the unit. In my case, the tuning voltage was almost proportional to the channel number, meaning the meter scale could be calibrated in channel numbers.

Another advantage of this system is that an indicator of the position of the tuning potentiometers would be provided, as this is no longer provided in the hardware. As well, it would be independent of everything and if the meter showed a particular channel, it would have to be correct.

The disadvantage of this approach is the need to fit a meter to the front panel. Apart from the possibility of damaging the panel, the meter would need to be relatively small, and I didn't have one on hand that would fit.

The second method is to decode the six channel select lines from the 68705 microprocessor (IC8) to give numerals on a 7-segment LED display to correspond with the channel number. The circuitry to do this is not complex, and involves some diode logic, a 7-segment LED display decoder-driver and the LED display. Obviously you would need to decide beforehand which channel corresponds to which control line. However, I decided against this idea due to the relative complexity.

As mentioned, I chose to use six LEDs to indicate the active control line to the tuner PCB. As it turned out, I was able to install the entire circuit onto the decoder PCB by drilling judiciously placed holes in the decoder PCB. The circuit diagram is shown in Fig.1, which as you can see comprises a hex CMOS buffer type 4050 driving six 3mm LEDs via 220-ohm resistors. The IC is powered by the +5V rail.

There are already two LEDs fitted to the decoder board, which indicate power

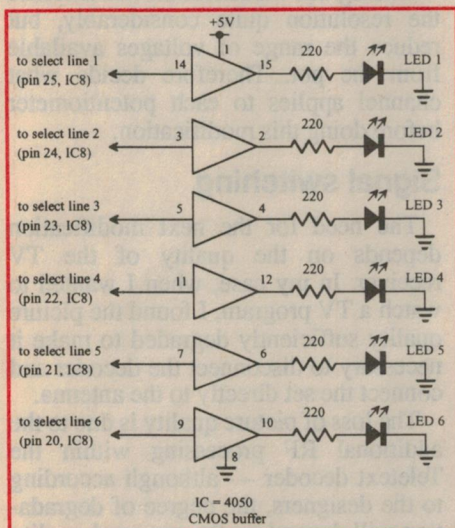


Fig. 1: The channel indicator uses a 4050 CMOS buffer to drive the six LEDs. When a control line from IC8 on the decoder PCB is high, the LED driven by that line will light. The text describes alternative arrangements.

Teletext decoder

and the reception of a command from the infrared remote control unit. So, to install the additional LEDs, I first drilled six holes into the earth track at the front of the decoder board.

I spaced the holes for the added LEDs 10mm apart, with the first LED (for control line 1) 60mm from the existing IR receive LED. The holes are roughly in line with those for the existing LEDs. The cathodes of the new LEDs are soldered to the earth track via these holes.

To mount and connect the IC, I used a wire-wrap, 16-pin IC socket, with holes drilled in the PCB for pins 8, (ground), 3, 5, 7, 9, 11 and 14.

The holes are drilled in the board between the six select-line tracks from IC8. The IC socket pins won't fit neatly into the new holes, but with minor bending and forming, it is easy enough to fit the socket. The track insulation needs to be scraped off to allow the pins to be soldered to each track.

The rest of the wiring is done on the top of the PCB, and formed to suit. The +5V supply can be obtained with a short link from pin 1 of the IC to the link adjacent to Q19 on the decoder PCB.

The anodes of each LED connect to the 220-ohm resistors which lie on the

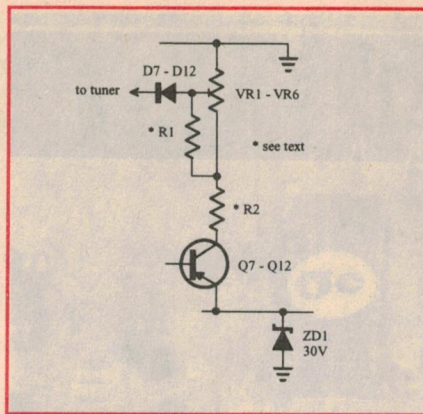


Fig.2: This circuit shows how to improve the resolution of the tuning potentiometers by adding resistors R1 and R2. All six tuning sections are the same, but the values of R1 and R2 depend on the tuning voltage required for the particular channel.

surface of the board. Plastic sleeving is needed to prevent shorts between leads that cross each other.

Drilling the front panel presents no problems, providing you're careful. I located the LEDs in line with the existing LEDs, spaced as for the holes drilled in the PCB.

Drill the necessary 3mm holes from the rear of the panel, and use a sharp drill. The inside of the holes can be blacked with a felt tip pen, making the new holes look the same as the originals.

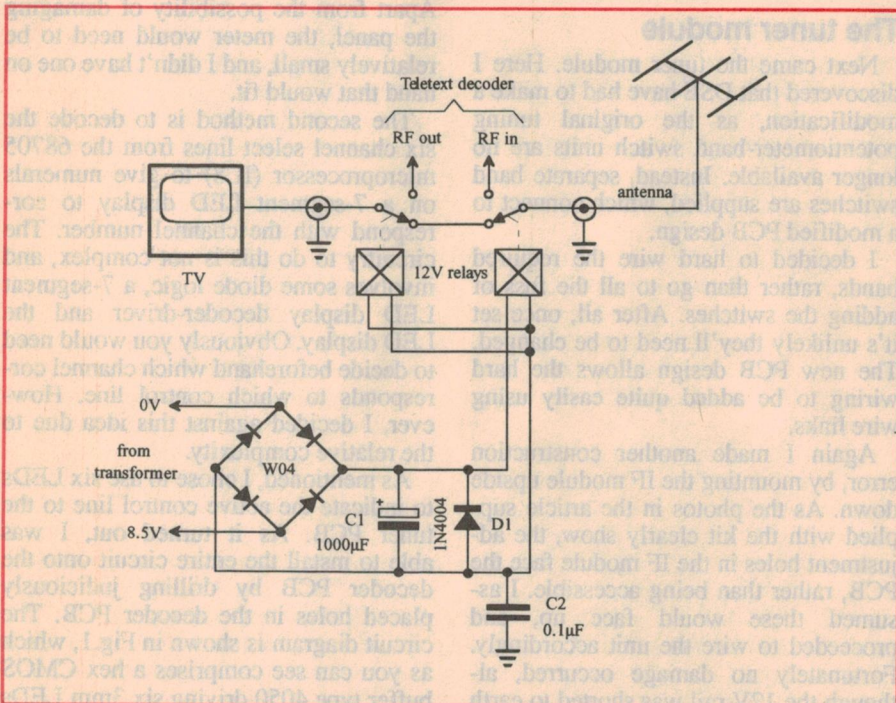


Fig.3: The relays that switch the RF signals are mounted in a jiffy box that connects to the RF IN and RF OUT terminals on the back of the decoder. The power supply to operate the relays is constructed on a tagstrip mounted inside the decoder case.

Tuning voltage

The next modification I installed was to give more resolution to the tuning potentiometers. I found during testing that the resolution of these pots made tuning quite critical.

My concern was that I would need to regularly re-tune each station, due to temperature changes affecting the resistance of the pots. As the pot shafts are located at the rear of the unit, I decided to try and overcome the problem before it arose.

However, as it turns out, so far the channels I left unmodified have exhibited no drift problems, so perhaps this modification is not required.

The circuitry will depend on the channel being modified, and basically requires the addition of one or two resistors. The circuit is shown in Fig.2, which is general in form as all six tuning sections are the same.

The values of the resistors depend on the tuning voltage for the particular channel and for a value of 6V (channel 2), R1 is deleted and R2 is 68k. For 10.9V (channel 7), R1 is 22k and R2 is 27k. For 12V (channel 9) both R1 and R2 are 22k. The channels I've stated are for Sydney, so I've included the tuning voltages to give interstate readers a guide.

To fit resistors R2, cut the required tracks and surface mount the resistors across the cut on the track side of the tuner board. Fit resistors R1 across the pads of the potentiometer.

Adding this modification will increase the resolution quite considerably, but reduce the range of voltages available from the pot. Therefore decide what channel applies to each potentiometer before doing this modification.

Signal switching

The need for the next modification depends on the quality of the TV receiver. In my case, when I wanted to watch a TV program, I found the picture quality sufficiently degraded to make it necessary to disconnect the decoder and connect the set directly to the antenna.

The loss of picture quality is due to the additional RF processing within the Teletext decoder — although according to the designers, the degree of degradation will depend on the type and quality of the TV receiver.

The solution was to add a small signal switching box in line with the antenna and the TV set, so that when the Teletext decoder is switched off, the antenna is directly coupled to the TV set.

Teletext decoder

Switch on the decoder and the signal goes via the decoder. This sounds simple, but it took quite a bit of doing as VHF signals can be difficult to shield.

To perform the switching function, I used two relays, chosen from the junk box for their small inter-contact capacitance. In other words, select a relay that has the smallest amount of metal in the armature arrangement and the contact arms. Ideally, a metal encased relay should be used, although wrapping metal foil around the case will provide adequate shielding.

The circuit for the arrangement is shown in Fig.3, and includes an additional power supply connected to the existing transformer. The two relays are located close to two RCA panel-mount sockets, fixed to the aluminium lid of a small jiffy box. It's essential to keep all unshielded signal leads as short as possible.

The antenna and the lead to the TV set plug into the panel mount RCA sockets on the jiffy box and two shielded leads fitted with RCA plugs connect to the decoder unit. Because the relays I used had plastic cases, I enclosed them with aluminium foil and connected the foil to the earth terminals of the RCA sockets. I also earthed the metal lid of the box to the case of the decoder. I constructed the power supply on a five-way tag strip, supported by a pillar next to the main transformer.

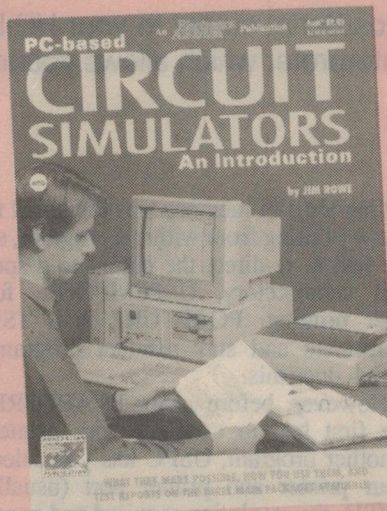
For neatness, I used a length of shielded cable as the power supply lead to the relays, connected via an RCA plug-socket combination. It's important to locate the lead well away from the decoder board to prevent RF noise being induced into sensitive circuitry on the decoder board by the lead.

Summary

This article has hopefully served two purposes — to give you confidence to go ahead and build the DSE Teletext decoder unit, and also to describe some useful additions. With or without the modifications, the unit works well, and may even be my key to an early retirement. (Hope springs eternal!)

The current design only supports two pages of Teletext data, although the PCB design accommodates a 4K RAM that can hold up to four pages. I'm told that if there is sufficient demand, the designer might push ahead with the necessary software update to support four pages. We'll keep you informed. ❖

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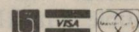
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PostScript interpreter program:

UltraScript version 3.01

Would you like to be able to send PostScript output to your HP LaserJet, or even to your dot matrix printer? UltraScript is a PostScript interpreter which allows you to do just that.

by **PETER MURTAGH**

UltraScript PC is an MS-DOS and Microsoft Windows 3.x compatible PostScript interpreter. It allows you to create PostScript documents in application programs (such as Windows,

WordPerfect, Microsoft Word, and many others) and to print directly from within your application on a non-PostScript laser, ink jet, or dot matrix printer. So, you can take advantage of your PostScript supported software without the expense of a PostScript output device.

The program is easy to install, and gives you the choice of loading drivers for DOS-based and/or Windows-based usage. The manual supplied assumes that you have a working knowledge of your PC and its operating conventions. You need to understand these to make it work, especially when operating within Windows. For example, while the manual does explain how to create an icon for UltraScript, you need to know how to configure your printer and how to have Windows automatically load your capture program.

Requirements for the program are an IBM PC/AT 286, PS/2 model 30- 286 and above, or any 100% compatible 80286, 80386 or 80486 computer, running DOS version 3.10 or higher. A hard disk is also needed, with at least 3.5MB of available free space.

While the program will run with 640KB minimum RAM, at least 1.5MB of total memory (640KB plus 800KB of additional XMS — 'extended' — memory) is required if you want to print from within your application. At least 2MB is recommended if you use Windows 3.x.

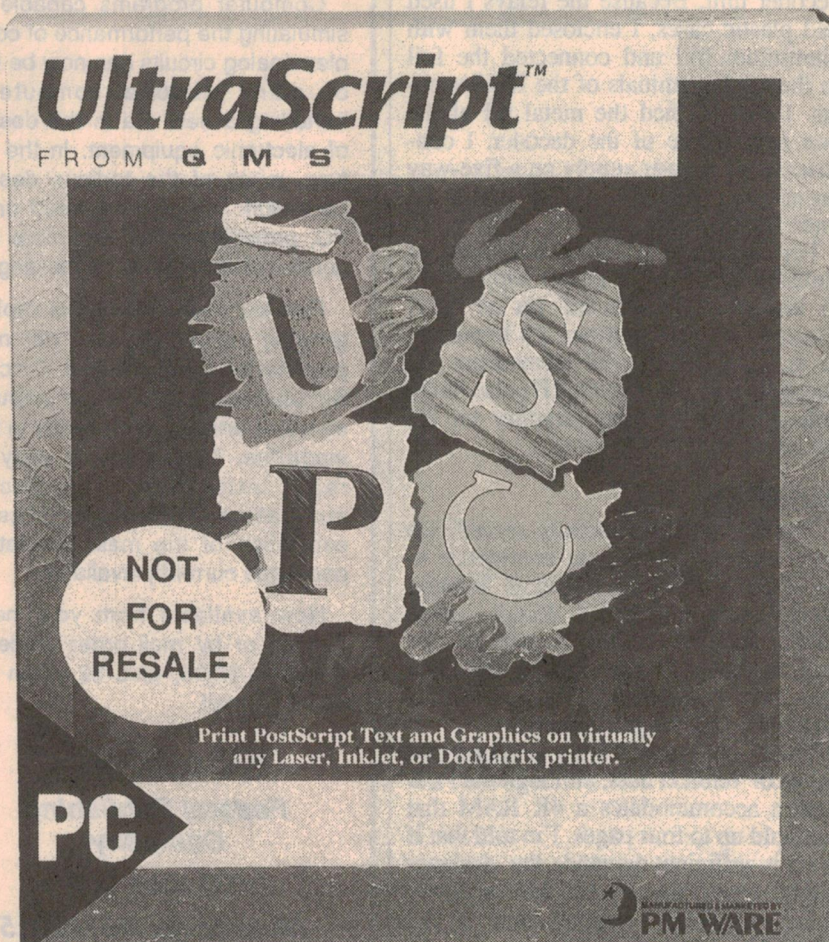
A series of programs are included to allow you to run UltraScript with this variety of configurations. We did not attempt to print using the 640KB minimum, as you are warned that such a setup is extremely slow. So our first printout was made on an AT- compatible, with 1MB of memory.

Our 1MB of memory was too small to allow printing from within a program, so we had to re-direct the output to a special subdirectory, USPC\$POOL, for later printing. PCAPTURE is a TSR (terminate and stay resident program) which does this.

However, before using PCAPTURE, we first had to configure our printer. Another program, USPC lets you select your printer and printer port (usually LPT1), the resolution required and paper

size, as well as the UltraScript printer port for the re-directed data (we used LPT2). Fig.1 shows one of the selection screens. USPC is also a printing program, so loading USPC/n speeds up the process by loading the 'configure' section only. The full program was loaded later when it was time to print.

So we loaded PCAPTURE, then loaded Protel Traxplot to print a simple PCB pattern on our Star 9-pin dot matrix printer. Traxplot was already set up to



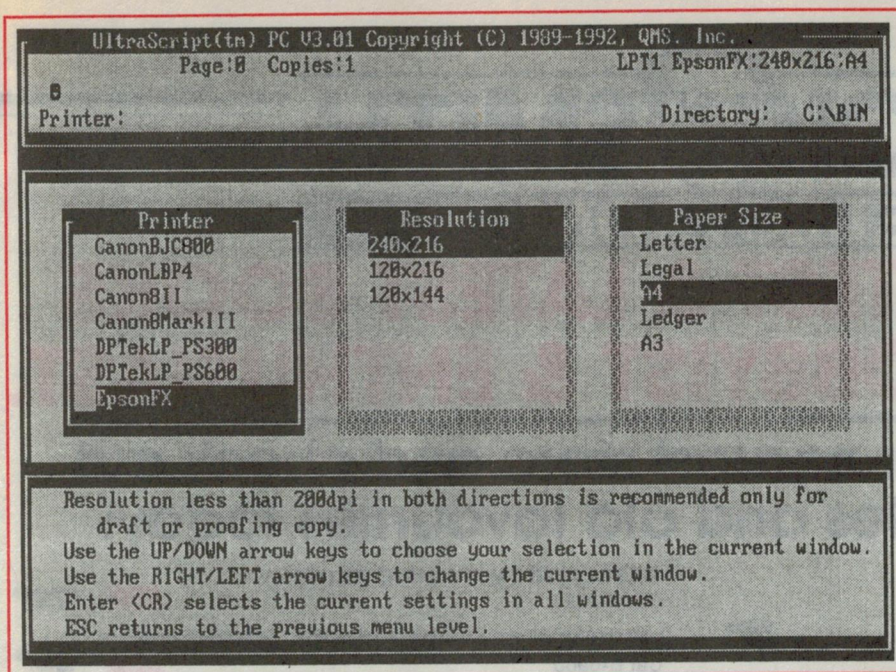


Fig.1: The 'printer configure' menu. This is part of the setup which must be made before running the PCAPTURE program which operates under DOS.

print in PostScript, so all that was necessary was to re-direct its output to LPT2. The captured file dutifully appeared in \USPC\SPOOL as file us000.ps.

After exiting Traxplot, we used PCAPTURE/r to remove the program to increase free memory space, then loaded USPC and printed the file.

At our first — unsuccessful — attempt, USPC said that there was insufficient memory. Because Smartdrive was loaded, UltraScript could only find 640KB. Smartdrive had to be removed to give UltraScript enough memory to make the printout. (Another program, USMEM can be run to tell you the amount of memory installed in your machine, as well as the amount available for UltraScript applications.)

A condensed print program, USPRINT, is provided for printout from computers with the minimum 640KB memory. We could have used this instead of removing Smartdrive.

Our second printout was made on a 386DX machine with 4MB of memory — more like the recommended hardware. This time we wanted to print out from CorelDraw, which runs under Windows. PCAPTURE and USPRINT are not used in this setup, but yet another program called US.EXE, which is automatically loaded by Windows after you modify the WIN.INI file.

Before doing this, we ran USMEM, and used it to allocate 2MB of free memory to UltraScript.

With Windows up and running, you

must next iconise (terrible word!) 'US' (UltraScript) so that you can select your output mode. You have the choice of using an UltraScript driver to make your printouts via 'US', or you can select a Windows driver and print from within your application. 'US' also provides a printer preview option.

In order to print directly from Windows, we went to the Control Panel and selected the recommended QMS ColorScript 100 Driver supplied with Windows.

The system was then set up to print to the USPC\SPOOL directory. The output from Windows was automatically captured and interpreted, and then re-directed to the dot matrix printer. This printout was excellent (see Fig.2), considering that it was printed on a 9-pin dot matrix machine.

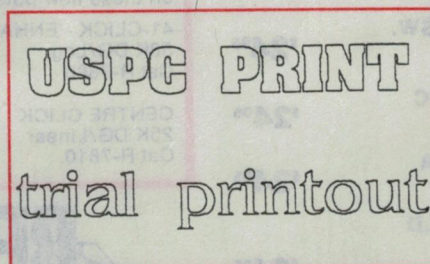


Fig.2: An example of the type quality produced by a 9-pin dot matrix printer. The CorelDraw text was 'printed' in PostScript mode, captured and interpreted by UltraScript, then re-directed to the printer.

Yet another printing choice is available — print from a DOS application within Windows. With this method, you can either output your file to the USPC\SPOOL directory, or you can load PCAPTURE before running Windows and let it re-direct the output.

If UltraScript is running in Windows, an immediate printout will be made — if not, the file will be printed the next time you start UltraScript.

Because so many printing options are offered, you need to read the manual very carefully to set up the one you decide on. But the instructions are there in sufficient detail to allow you to do so.

The major disadvantage of UltraScript is its speed, but this is only to be expected, considering that the output file must be captured and interpreted, and — in our case — all printouts were done on a dot matrix machine.

The speed will obviously be increased if you are using a faster computer and printer, and are able to allocate larger amounts of memory to UltraScript. Of course, the major advantage of the program is that it lets you make printouts that would not otherwise be possible. It is certainly a lot cheaper than buying a PostScript printer!

Three kinds of fonts are supported by UltraScript: QMS proprietary outline fonts which work only with the UltraScript PC interpreter; user-defined fonts (Type 3 fonts as defined in the Adobe PostScript reference manual); and Adobe Type 1 fonts.

The standard UltraScript packages come supplied with seven UltraScript fonts, and the *plus* versions have an additional seven. Packages containing extra fonts are also available.

The manual supplied is very good, and easy to follow. Particularly useful are sections on 'Tips and Hints' and 'Troubleshooting'. Previous versions of UltraScript were deficient in these areas. Several months ago I gave up trying to run version 2.3 because of various problems. These bugs have obviously been corrected, since I was able to run version 3.01 without any such troubles at all.

The prices for the various formats are: UltraScript PC and UltraScript Mac, \$269; PC+ and Mac+, \$593 and \$647; and the additional fonts are available for \$105-\$195 per package.

Postage in Australia is an additional \$10, with express road freight for \$20. Postage is free with pre-paid orders.

The UltraScript packages are available from ME Technologies, P.O. Box 50, Dyers Crossing 2429; phone (065) 50 2254. ♦

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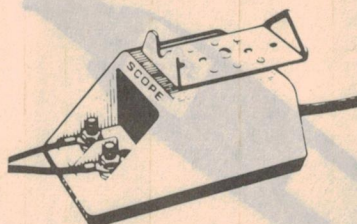


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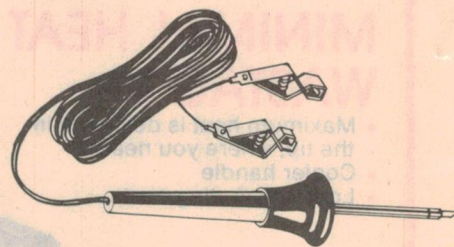


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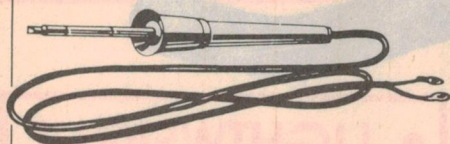
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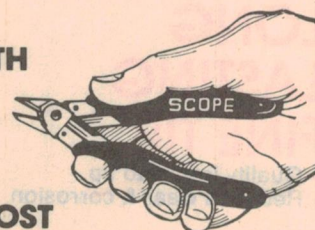
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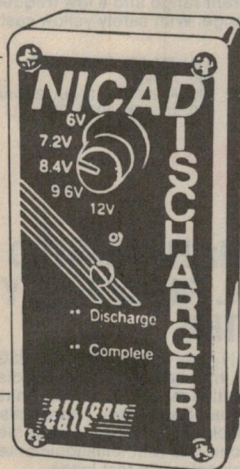


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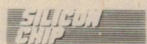


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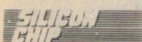
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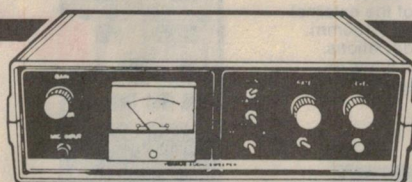
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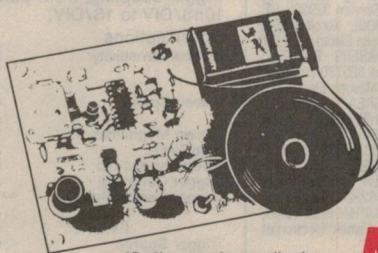
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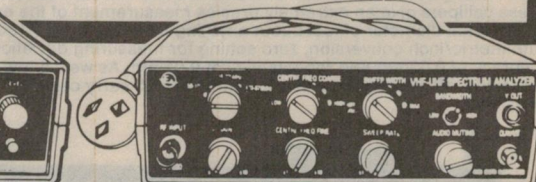
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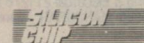
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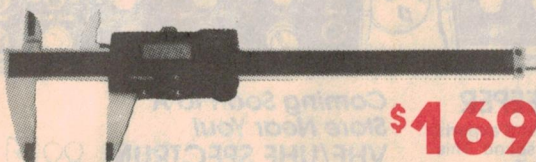
Ranges:
DCV: 0.2V, 2V, 20V, 200V, 1000V
ACV: 200, 750V
DC Current: 200uA, 2000uA, 20mA, 200mA
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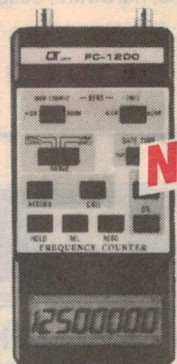
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Specifications

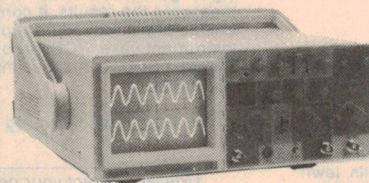
Measuring Range: 10Hz to 1.25 GHz
Impedance: 1M OHM
Accuracy: +/- (1PPm + 1d)
Range: Channel A: 500MHz/1250MHz
Channel B: 10MHz (10Hz to 10MHz)
Typical Sensitivity: Channel A: 10-1000 MHz (3-50mV RMS)
= 1-1.25GHz (10-150mV RMS)
Channel B: 10Hz-1MHz (15mV RMS)
1MHz-5MHz (20mV)
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Max Voltage
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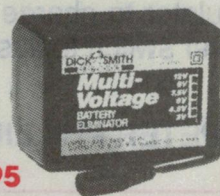
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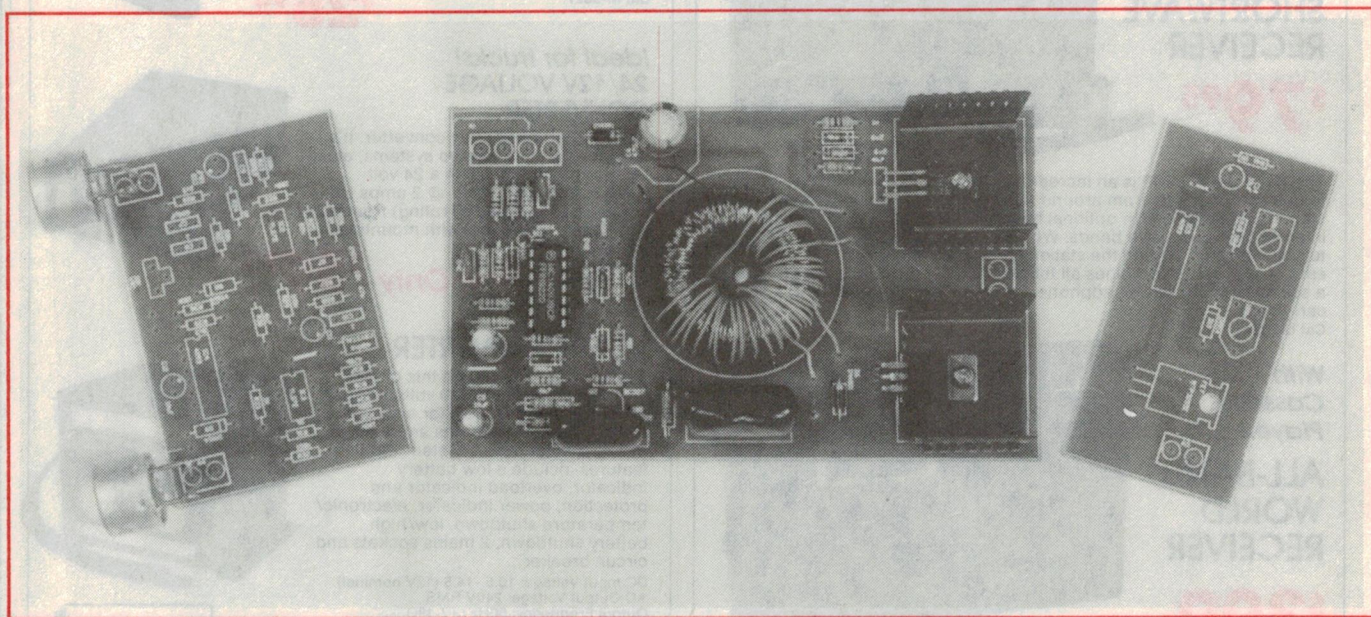
STORES ACROSS AUSTRALIA AND NEW ZEALAND

Construction Project:

A Multifunction Fluoro Light

The title of this project doesn't do it justice. What do you call (in three words) a project that includes an efficient 12V inverter to operate a range of fluorescent tubes at full brilliance, an onboard regulator to charge the 12V battery from a solar cell, an ultrasonic movement detector and a FET power switch to flash an emergency light? And there's lots more...

by PETER PHILLIPS



This project comes from the design team at Oatley Electronics, and is aimed at those who want a versatile project at the best possible price. It started out as an all-new 12V fluorescent lamp inverter, which by itself will be popular with constructors. But, as regular readers know, fluorescent lamp inverters have been described before, so the team decided to extend things a bit. Well, more than just a bit...

The most important part of this project is the inverter itself, designed by Conrad Marder. Ideally, an inverter should have a high efficiency and be able to drive a range of tubes to full brilliance. This one has all this: it has an efficiency better than 90% and can power fluorescent tubes ranging from 6W to 20W, to almost the same light output as if they're operated from the mains.

For instance, a 20W tube takes 1.4A at 12V (17W of input power), with a light

output of around 16W, or about 80% of its normal rated output. Because the tube is operating at slightly less than its full rated output, the tube life is extended, and you won't really notice the difference in the light output. However, if you want more light output, simply change a resistor value.

To give a range of options on how to turn the light on and off, the design team included a digital interface. This part of the circuit allows the light to be switched on by any device that delivers a pulse. There's also a timer in the circuit (that can be disabled with a

link), so a pulse input can turn on the light for three minutes or so. You can also add an LDR (light dependent resistor), so the light is automatically disabled during daylight.

There are two inputs: one that accepts a positive pulse and the other a negative pulse. This way, you can operate the light from a PIR detector, a pushbutton, an infrared or RF remote control; anything that gives either a positive or a negative-going pulse.

To make the project attractive to as many people as possible, the designers also included a regulator to allow the 12V battery to be charged from a solar panel. The regulator prevents the battery from overcharging, but is only for use with a solar panel. If you want to trickle charge the battery from the mains, you simply leave out the regulator section and add your own battery charger.

All of the sections described so far are

Warning

This project produces a high voltage that could be lethal. Don't operate the inverter unless a fluorescent tube is connected and don't touch the wires from the secondary of the toroid.

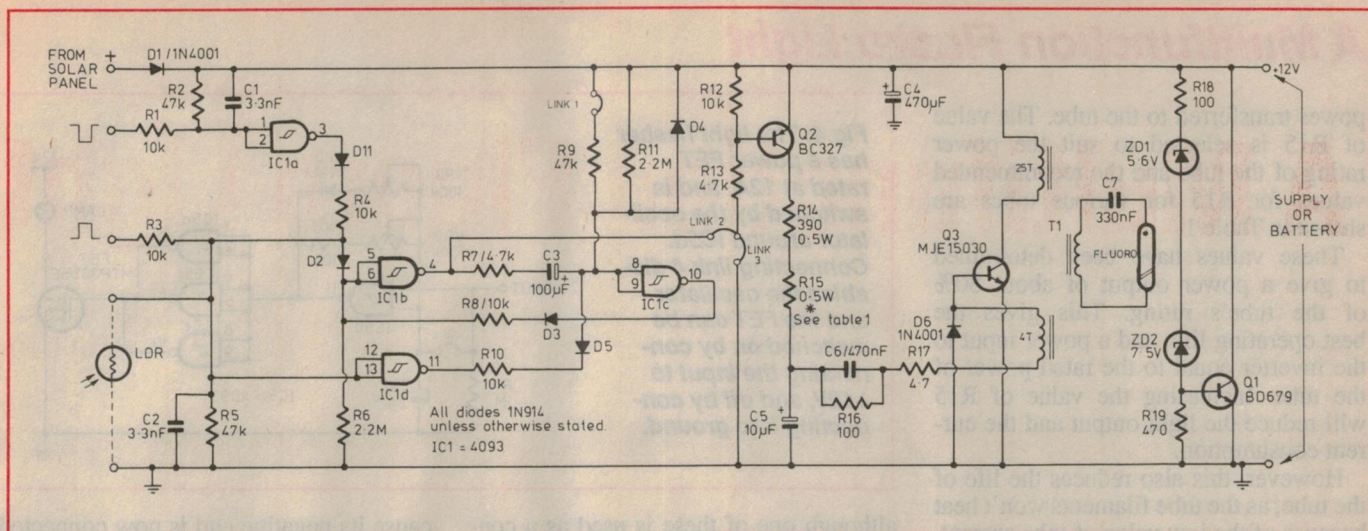


Fig.2: The circuit around IC1 includes a timer that is triggered by either of two inputs. The inverter uses a toroidal transformer and oscillates at about 40kHz. The regulator section around Q1 prevents the 12V battery from overcharging if the unit is connected to a solar panel.

on the one PCB — which by the way, is a professionally made, silk-screened board. However, because the cost of a PCB is not directly related to its size, Oatley Electronics decided to add two more sections. The first is an ultrasonic movement detector.

This part was presented as a project in April 1990, (page 80) and the circuit here is identical. However, the PCB section has been re-designed to suit the rest of the board. As an incentive, the basic kit for this project includes the ultrasonic transmitter and receiver, so if you have all the other bits, you get this section for free. This PCB section is electrically independent of the main PCB, so it can be either left attached or separated, as desired.

You can use the detector to trigger the light, so if you need a light that comes on if someone enters a room, here it is. The ultrasonic detector section can be placed away from the light to suit, or left attached to give an integrated unit.

The last part is a FET power switch with an on-board low-frequency oscillator. This section can be used as an electronic on-off switch for a light, or to flash a light, such as a beacon or a warning light on a boat. Like the ultrasonic movement detector, the power switch section of the PCB is independent, and the parts for this section are not included in the basic kit.

So, as you can see, this is a very versatile project. It caters for those who already have a stock of components, but who can't make their own boards, as well as for constructors who want to adapt the project to a special need. In short, it's the ideal hobbyist project — cheap and very versatile.

Table 1

Tube power	R14 + R15	R15	Current at 12V
4W	2.5k	2.2k	0.4A
6W	1.5k	1.2k	0.6A
8W	1.4k	1k	0.7A
13W	1.2k	820Ω	1A
15W	680Ω	390Ω	1.1A
18-20W	470Ω	100Ω	1.4A

The project will be sold as a kit, and for \$39 you get everything shown in Fig.1. Add an extra \$16, and you get all the extra components to complete the two extra PCB's. See the end of the article for further details.

The inverter

The circuit on the main PCB is shown

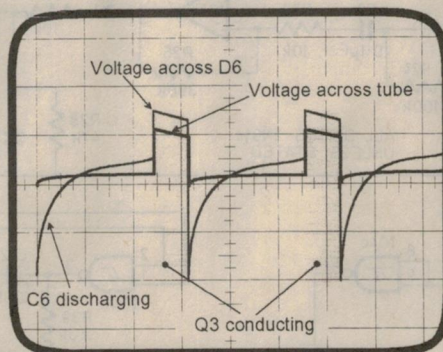


Fig.3: As these waveforms of the inverter show, energy is supplied to the tube when the transistor is conducting. Diode D6 in the circuit prevents the negative spike damaging the transistor.

in Fig.2. There are three sections to the circuit: the inverter (around Q3), the digital interface (around IC1) and the solar regulator section (around Q1).

The inverter is basically a blocking oscillator. When Q2 is on, base current is supplied to Q3 via R14 - R17 and the feedback winding of T1. This turns Q3 on, and current starts to flow in the primary winding of T1. The current will quickly increase, inducing a voltage in the feedback winding that makes Q3 turn on even harder.

Eventually the current will reach its maximum value, causing the induced voltage in the feedback winding to fall. The reduced base voltage to Q3 will make Q3 start to turn off, reducing the current flowing in the transformer. The effect is cumulative (or regenerative) and Q3 is quickly turned off as the feedback voltage falls even further. The cycle then repeats.

The waveforms for the inverter are shown in Fig.3. Notice that the transistor is on for about 25% of the whole cycle, and that the voltage across the tube is virtually zero until the transistor is on. In other words, energy is transferred to the tube while Q3 is on. The maximum voltage across the tube is around 60V (for an 8W tube).

The frequency of the oscillator is about 40kHz, mainly determined by the values of C6 and R17. As the waveforms show, capacitor C6 is charged with a negative voltage when Q3 is switched off, and has to discharge before Q3 can switch on again.

The values of R14 and R15 also affect the frequency, and more importantly, the collector current in Q3. These resistors therefore determine the amount of

A Multifunction Fluoro Light

power transferred to the tube. The value of R15 is selected to suit the power rating of the tube and the recommended values for R15 for various tubes are shown in Table 1.

These values have been determined to give a power output of about 80% of the tube's rating. This gives the best operating life, and a power input to the inverter equal to the rated power of the tube. Increasing the value of R15 will reduce the light output and the current consumption.

However, this also reduces the life of the tube, as the tube filaments won't heat because of the low value of tube current. Although the filaments are not heated directly as in some designs, they will heat if the tube current is sufficient.

Digital interface

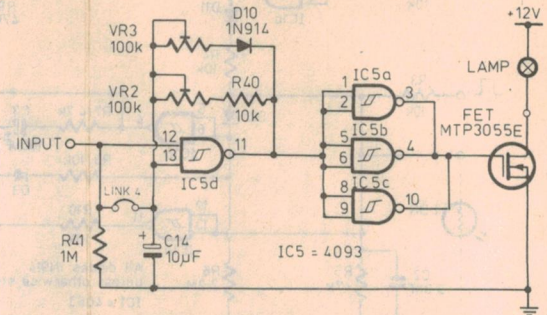
The inverter is switched on and off by Q2. If you wanted nothing else but the inverter, Q2 could be removed and a switch connected in place of the emitter and collector terminals.

Another way to directly switch the inverter on and off is to connect a switch in place of link 3. Or, if link 3 is connected, the on-off switch could be in series with the 12V supply.

The digital interface provides an even greater range of switching options. When the interface is being used, link 3 is deleted and link 2 is connected.

There are three inputs to the circuit,

Fig.4: The light flasher has a power FET rated at 12A, and is switched by the oscillator around IC5d. Connecting link 4 disables the oscillator and the FET can be switched on by connecting the input to +12V, and off by connecting it to ground.



although one of these is used as a connection for an LDR. The other two accept a pulse, perhaps from the ultrasonic movement detector or any similar device.

As the circuit shows, a negative pulse is applied to R1 and a positive pulse to R3. If R1 is momentarily connected to ground, the output of IC1a will switch to a high. This makes the output of IC1b switch low, which is passed to the input of IC1c via C3. If link 2 is connected, the low at the output of IC1b will switch Q2 on, allowing the inverter to operate.

The output of IC1c will now be high, which then holds the input of IC1b high, with its output low. The circuit is then held in this state regardless of the input condition to R1.

However, the positive side of C3 is connected to the supply via R11. Be-

cause its negative end is now connected to a low, C3 will charge towards 12V. When C3 has charged sufficiently, the input to IC1c will be a logic 1, causing its output to switch low. This makes the output of IC1b switch high, turning off the inverter and returning the timer to its stable state.

The circuit around IC1b and IC1c is therefore a monostable, with a time delay determined by the values of C3 and R11. The time delay is around three minutes which can be altered by changing the value of either C3 or R11. If link 1 is connected, the delay is reduced to virtually zero, as R9 is then in parallel with R11. This link is connected if you want to use the inputs to switch the light on and off without having a delay for the turn-off time.

Applying a positive input to R3 has

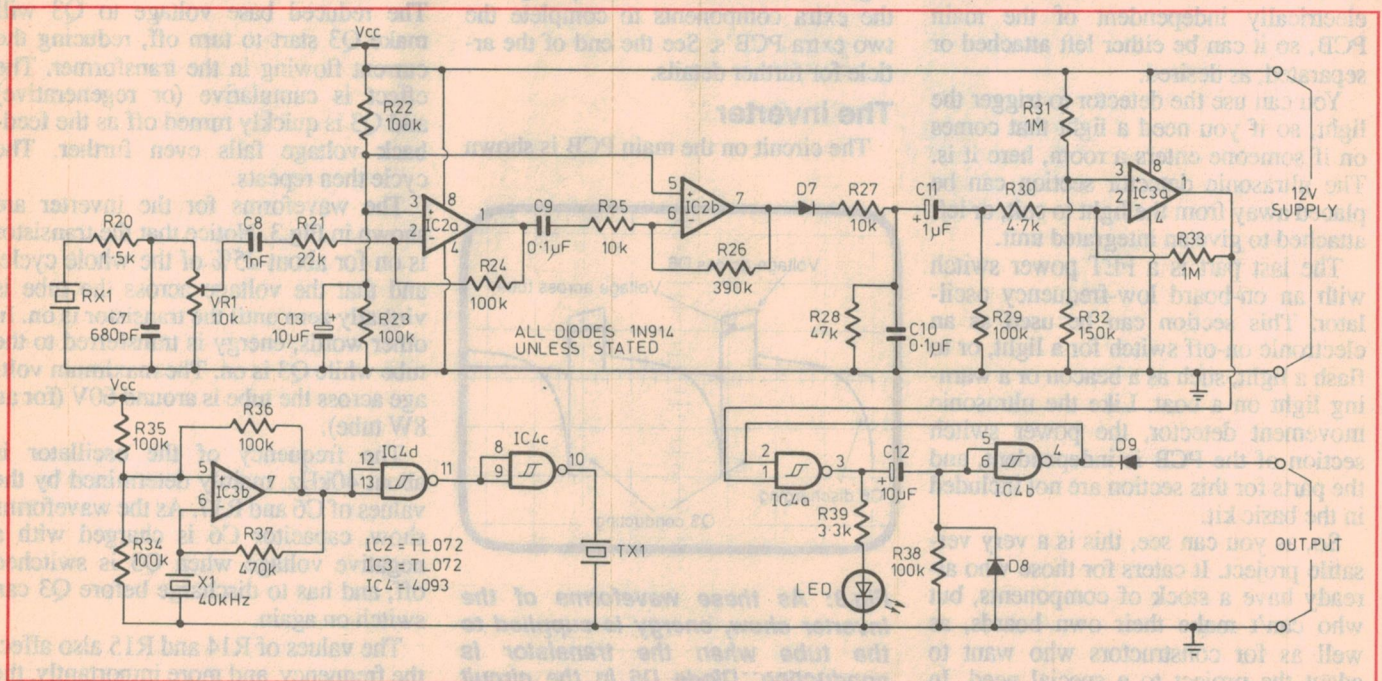


Fig.5: The ultrasonic movement detector has a crystal-locked, 40kHz oscillator connected to an ultrasonic transmitter. The received signal is amplified by IC1a-b.

the same effect as a negative input to R1. This pulse is applied directly (via isolating diode D2) to IC1b as it is the right polarity to trigger the timer.

If an LDR is connected as shown in the circuit diagram, both trigger inputs are disabled if the LDR resistance is low. This happens under normal daylight conditions, but in darkness, the LDR resistance will be over 1M ohm, allowing the circuit to respond to a pulse at either input.

Incidentally, you can connect a pushbutton to either input. For example, connecting a pushbutton between the negative input (at R1) to ground will give a negative input pulse when the button is pressed. Or the pushbutton could be connected between the positive pulse input (at R3) and the 12V supply.

Another method is to use a switch, connected as described for the pushbutton. In this case, IC1d takes over and holds the timer on.

For example, if the input end of R1 is connected to ground, a logic 1 will be applied to the input of IC1d, giving a low at its output. This will forward bias D5 and pull the input of IC1c low, regardless of the state of C3. The timer is then held permanently in this condition, with the output of IC1b low. Therefore, the inverter is switched on as long as the switch is closed.

If link 1 is not connected, there will be the usual time delay when the switch is

turned off. Connecting link 1 eliminates the delay.

Solar regulator

This section is a shunt regulator and connects across the battery. As already explained, the regulator is only for use with a solar panel. Without the regulator, it's possible to overcharge a battery from a solar panel, as the output voltage of the panel will rise as the load current falls. The open-circuit voltage of a solar panel designed to charge a 12V battery can be over 20V, and the regulator simply bypasses the charge current when the voltage across it is higher than 14V or so.

The circuit has two zener diodes, connected in series to give a total zener voltage of 13.1V. Base current therefore flows in Q1 when the zeners are forward biased and there is at least 0.8V across R19. When Q1 (a 4-amp Darlington transistor) is forward biased, current flows from the supply to ground through Q1, bypassing the charge current from the solar panel.

Flasher unit

This section is independent of the main board and consists of an oscillator (around IC5d) that switches a power FET. The recommended FET has a current rating of 12A, allowing the unit to drive high power lamps.

The circuit is shown in Fig.4, and has

two adjustments that independently determine the on and off times. The oscillator operates only when the input is at a logic 1. If this input is low, the output of IC5d will be held high, and due to the inverting action of the parallel connected NAND gates IC5a-c, a low is applied to the gate of the N-channel FET, holding it off.

When the input is held high (by connecting it to +12V), the output of IC5d will be a low, causing C14 to discharge via VR3 and D10. This capacitor will have previously been charged, because the output of IC5d was high. When the capacitor voltage falls to a logic 0, the output of IC5d will switch to a high, and C14 will start charging again, this time through R40 and VR2. When the capacitor voltage reaches a logic 1, the output of the gate will switch low, and the cycle continues.

Because of the inverting buffer stage, the FET is switched on when the output of IC5d is a low. When link 4 is connected, the oscillator is disabled. If the input is then connected to +12V, the FET is turned on. Connecting the input to ground turns the FET off. In other words, the input directly switches the FET.

Movement detector

The circuit for the detector is shown in Fig.5. This circuit is identical to the ultrasonic movement detector described

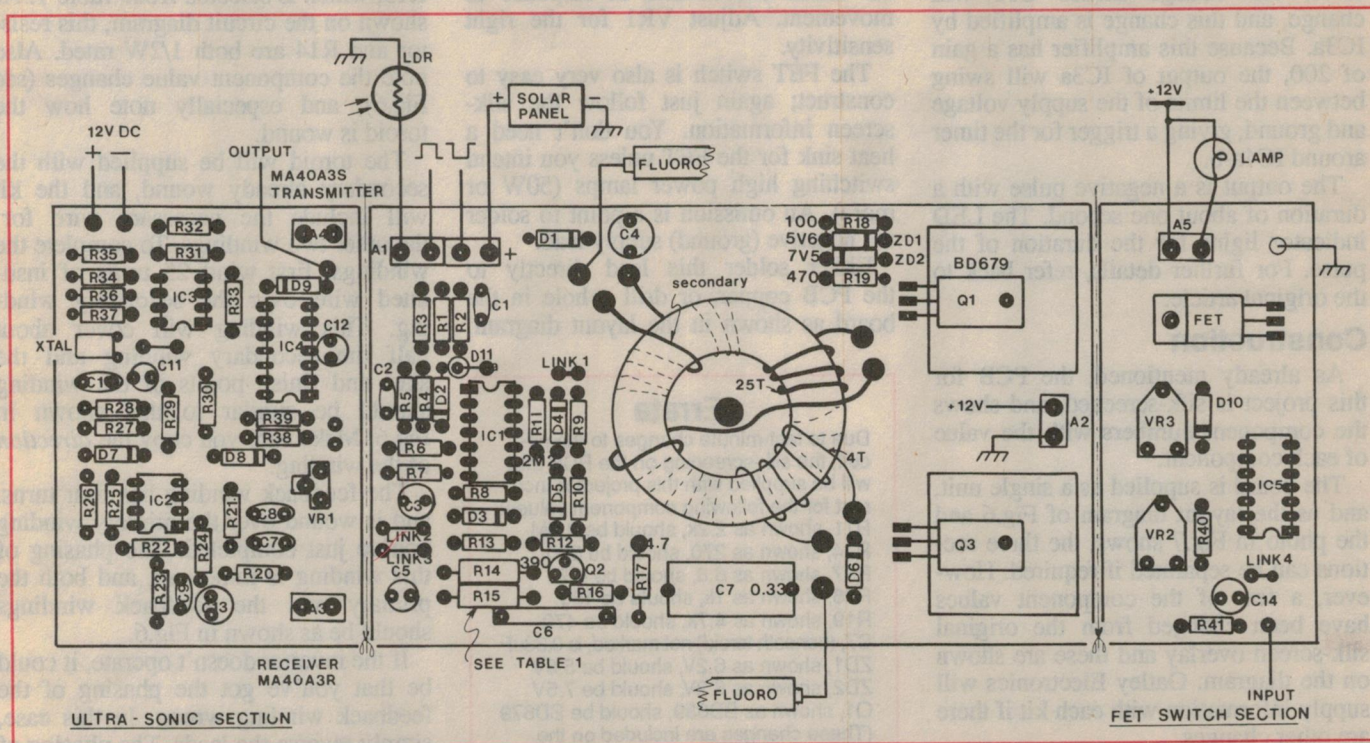


Fig.6: The silk-screen on the PCB supplied with this kit has several incorrect component values. The correct values are shown here. Also shown are the various connections and how the toroid is wound.

A Multifunction Fluoro Light

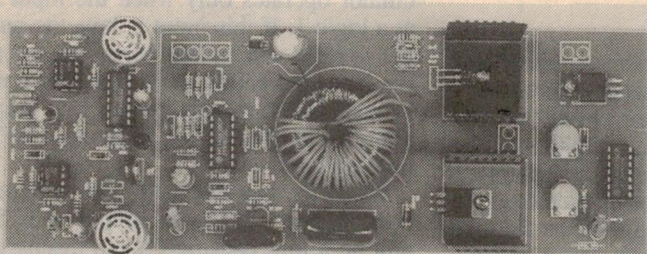


Fig.7: This photo shows all three boards with their components in place. The toroid can be held in place with a nylon screw through the PCB, and a plastic washer fitted on top of the toroid.

in EA April, 1990, except the component numbers have been changed to suit the new PCB. Basically, a 40kHz oscillator is formed by the circuitry around IC3b, which couples directly to the ultrasonic transmitter (TX).

The rest of the circuit is the receiver. The output of the ultrasonic receiver (RX) is amplified by the inverting amplifier of IC2a, and the sensitivity of the circuit is set with VR1. The inverting amplifier of IC2b further amplifies the signal, giving a total gain of about 2000.

This signal is half-wave rectified by diode D7, charging C11. If the received signal is constant, the voltage stored on C11 will be constant. If the received signal changes in frequency or level, the voltage across C11 will change, and this change is amplified by IC3a. Because this amplifier has a gain of 200, the output of IC3a will swing between the limits of the supply voltage and ground, giving a trigger for the timer around IC4a-b.

The output is a negative pulse with a duration of about one second. The LED indicator lights for the duration of the pulse. For further details, refer back to the original article.

Construction

As already mentioned, the PCB for this project is silk-screened, and shows the component numbers with the value of each component.

The board is supplied as a single unit, and as the layout diagram of Fig.6 and the photo in Fig.7 shows, the three sections can be separated if required. However, a few of the component values have been changed from the original silk-screen overlay and these are shown on the diagram. Oatley Electronics will supply information with each kit if there are other changes.

Construction of the ultrasonic movement detector section is straightforward

— simply follow the silk-screen layout. As the photo in Fig.7 shows, the transmitter and the receiver are fixed to the PCB with short lengths of tinned copper wire. Make sure you don't accidentally swap the receiver and the transmitter. The receiver is coded MA40A3R and the transmitter MA40A3S.

Be careful not to apply too much heat when you're soldering the crystal. Also check the polarity of the three electrolytic capacitors, the three diodes and the LED before you solder them in.

Once you've built the unit, it can be tested by connecting it to a 12V DC supply and confirming that the LED lights when there's movement in front of the sensors. The LED should come on for about one second in response to movement. Adjust VR1 for the right sensitivity.

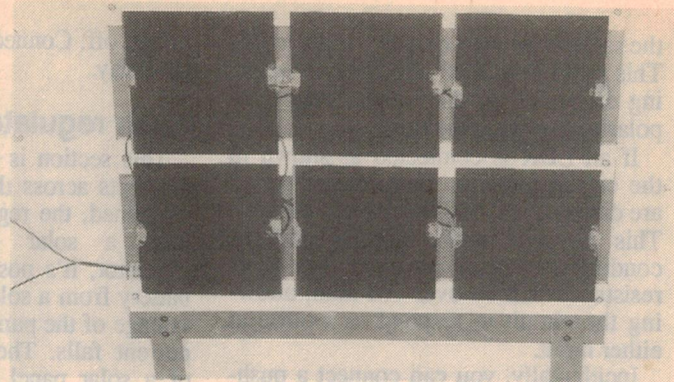
The FET switch is also very easy to construct; again just follow the silk-screen information. You don't need a heat sink for the FET unless you intend switching high power lamps (50W or more). An omission is a point to solder the negative (ground) supply lead.

Either solder this lead directly to the PCB copper, or drill a hole in the board as shown in the layout diagram.

Errata

Due to last-minute changes to the circuit, the silk-screening on the PCB that will be supplied with this project is incorrect for the following component values:
R11, shown as 2.2k, should be 2.2M
R14, shown as 270, should be 390
R17, shown as 6.8, should be 4.7
R18, shown as 1k, should be 100
R19, shown as 4.7k, should be 470
C7, (beneath toroid) not marked, is 0.33uF
ZD1, shown as 6.2V, should be 5.6V
ZD2, shown as 6.2V, should be 7.5V
Q1, shown as BD639, should be BD679
(These changes are included on the PCB layout in Fig.6)

Fig.8: This shot shows how to make a roof mounted solar panel. Each solar panel is glued to insulating strips attached to an aluminium back plate. The two aluminium legs slot under the roof tiles to hold the assembly in place.



Connect link 4 if you want the unit to act as a switch, but leave it out if you want the oscillator to operate the FET in flashing mode.

The external wiring to the board is shown in the layout diagram. To test the board, simply wire it as shown and confirm that the lamp operates as described previously.

Construction of the main PCB is also a matter of following the silk-screen layout design. You may not want to include all sections, such as the solar panel regulator or even the logic interface. Simply leave these components out if they are not needed.

The only other decisions to make are what links you need and the value of R15, which is selected from Table 1. As shown on the circuit diagram, this resistor and R14 are both 1/2W rated. Also note the component value changes (see Fig.6), and especially note how the toroid is wound.

The toroid will be supplied with the secondary already wound, and the kit will include the necessary wire for the other two windings. To complete the windings, first wind 25 turns of insulated wire over the secondary winding. This winding will cover about half the secondary winding and the start and finish points of the winding should be similar to that shown in Fig.6. Make sure you copy the *direction* of the winding.

The feedback winding has four turns, and is wound over the primary winding you've just completed. The phasing of this winding is important, and both the primary and the feedback windings should be as shown in Fig.6.

If the inverter doesn't operate, it could be that you've got the phasing of the feedback winding wrong. In this case, simply reverse the leads. The phasing of the secondary winding is not important.

Otherwise the usual precautions apply.

PARTS LIST

Main PCB:

Resistors

All 1/4W, 5% unless otherwise stated:

R1,3,4,8,10,12	10k
R2,5,9	47k
R6,11	2.2M
R7,13	4.7k
R14	390 1/2W
R15	see Table 1 (1/2W)
R16,18	100 ohm
R17	4.7 ohm
R19	470 ohm

Capacitors

C1,2	3.3nF ceramic
C3	100uF 16V electrolytic
C4	470uF 16V electrolytic
C5	10uF 50V electrolytic
C6	0.47uF 100V polyester
C7	0.33uF 400V polyester

Semiconductors

D1,6	1N4004 diode
D2-5,D11	1N4148/1N914 signal diode
ZD1	5.6V 1/2W zener diode
ZD2	7.5V 1/2W zener diode
Q1	BD679 NPN transistor
Q2	BC327 PNP transistor
Q3	MJE15030 NPN transistor
IC1	4093 quad Schmitt NAND

Miscellaneous

Silk-screened PCB coded OE/92/FCONT,

220 x 88mm; 2 x heatsinks; pre-wound toroid, hook-up wire.

Ultrasonic PCB

Resistors

All 1/4W, 5% unless otherwise stated:

R20	1.5k
R21	22k
R22,23,24,29,R34,35,36,38	100k
R25,27	10k
R26	390k
R28	47k
R30	4.7k
R31,33	1M
R32	150k
R37	470k
R39	3.3k
VR1	10k PCB mount trimpot

Capacitors

C7	680pF ceramic
C8	1nF monolithic
C9,10	0.1uF monolithic
C11	1uF 50V electrolytic
C12,13	10uF 50V electrolytic

Semiconductors

D7-9	1N4148/1N914 signal diode
IC4	4093 quad Schmitt NAND
IC2,3	TL074 dual op amp
LED	red, 2mm or 4mm
X1	40kHz crystal
RX1	ultrasonic receiver, MA40A3R
TX1	ultrasonic transmitter, MA40A3S

Miscellaneous

Silk-screened PCB coded OE/92/FCONT, 220 x 88mm; hook-up wire

FET switch PCB

Resistors

R40	10k 1/4W
R41	1M 1/4W
VR2,3	100k PCB-mount trimpot

Capacitors

C14	10uF 50V electrolytic
-----	-----------------------

Semiconductors

D10	1N4148/1N914 signal diode
FET	MTP3055E N-channel power FET
IC5	4093 quad Schmitt NAND

Miscellaneous

Silk-screened PCB coded OE/92/FCONT, 220 x 88mm; hook-up wire

Kits of parts for this project are available from:

Oatley Electronics
5 Lansdowne Parade,
Oatley West, NSW 2223.
Phone (02) 579 4985

Postal address (mail orders):

PO Box 89, Oatley West NSW 2223.

Kit containing all PCB components, silk-

screened PCB as shown in Fig.1.....\$39.00

Components for FET switch and ultrasonic

movement detector.....\$16.00

Post and packing.....\$5

That is, watch the polarity of all diodes, transistors, ICs and electrolytic capacitors. Also, make sure that D1 and D6 are 1 amp diodes; all the rest are signal diodes. Diode D11 (next to pin 8 of IC1) is mounted vertically, with the cathode end next to D2.

Heatsinks are needed for Q3 and Q1, and are fitted directly between the component and the PCB. Insulation between the component and the heatsink is not essential, although both heatsinks will be at a potential of 12V. If there is any chance of a short-circuit between either heatsink and ground, fit an insulating washer.

To test the unit, connect a fluorescent lamp that has the correct power rating for the chosen value of R15. **Don't run the inverter unloaded, as the output voltage will be very high, and could cause damage.** Obviously, be very careful not to touch the wires from the secondary of the toroid. The tube filaments should be joined at each end, so the transformer secondary leads connect to both pins. Apply 12V DC to the board, and check that the light operates when link 3 is joined. The current consumption should be close to that shown in Table 1 for the particular tube you're using. If the light doesn't operate, check the phasing of the feedback winding. Otherwise, you might have made a mistake in your assembly. This project has been tested extensively, and the design is well proven.

Applications

It's impossible to describe all the possible uses for this project. It has been designed to give a great many options, so perhaps a good place to start is with the solar power option. Unless you have a large solar panel, the inverter is not intended to be operated directly by solar power. Instead, a solar panel, such as that shown in Fig.8 could be mounted outside, perhaps on the roof.

The panels are connected in series, and the unit shown in the photo can deliver 6W or more of charge to a 12V battery. The panels in the photo have been attached with silicon glue to plastic backing strips, fixed to an aluminium backing plate.

By using solar power, the project is completely independent of the mains as the solar panel charges the 12V battery that powers the circuit. Oatley Electronics have a range of solar panels and suitable 12V batteries (lead-acid gel cell type) for this project. This arrangement would suit an emergency light in a house, campervan, caravan, tent, boat or any application where the unit is independent of mains power.

As already described, the light can be switched in a variety of ways. Using the ultrasonic movement detector will give a light that operates when movement occurs in the targeted area — perhaps in a dark hall, a staircase or near the front door.

An excellent application is as a 'solar skylight'. Rather than go to the expense of fitting a skylight in the roof, fit a solar panel instead. Then mount the fluorescent lamp inverter, (with a 12V rechargeable battery connected to the solar panel), add a movement detector, and light up the area 'electronically'. Much simpler, and far cheaper.

The light can also be connected to an existing alarm system, or to any sensor that produces a positive or a negative pulse.

The light flasher is an option intended for boat owners, but it has general uses. It is possible to connect the fluorescent light to the flasher, but repeated switching of the light will shorten the life of the tube. Instead, use an incandescent light, perhaps as a warning light on a boat, as a beacon or even as an indicator.

The flasher unit can be operated by the logic interface on the main PCB by connecting its input to the output of IC1b. This way you get all the variations possible with the logic interface, this time operating the flasher, with or without the fluorescent light.

In short, there are an almost unlimited number of possibilities with this project. However, we shouldn't forget that the centre-piece is a battery-powered fluorescent light that operates as though connected to the mains. So, combining the lot, you can see that this project is perhaps one of the most versatile we've published for some time. ♦

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Computer controlled power supply

Often, when interfacing equipment to computers, the problem of a suitable power supply is encountered. This circuit was designed to overcome this situation by allowing the user to select the required voltage from software, thus eliminating the inconvenience of a separate power supply or custom building one to suit.

The power supply is able to provide voltages from 0 to 18 volts, at currents of up to 3A, using an adjustable voltage regulator. There are 16 available voltage outputs or channels that can be calibrated during the initial setup, then simply selected as required by the computer.

The circuit is quite standard, using transformer T1 (M-2165) to reduce the voltage to 21 volts AC. This is rectified by the four diodes D1-D4 (1N5404) and filtered by C1 and C2 (4700uF 35V), before entering the adjustable voltage regulator IC1 (LM350K, TO-3 case).

The output voltage of the regulator is determined by a resistive divider and can be calculated as follows:

$$V_{OUT} = 1.25(1 + R2/R1)$$

For the circuit shown, R1 is fixed to 120 ohms while R2 can be adjusted by the 2k trimpot (RV1 - RV16) and pre-set to the desired voltages. A list of resistance values is given for common voltages:

Voltage	R2 (ohms)
1.5V	24
3.0V	168
4.5V	312
5.0V	360
6.0V	456
7.5V	600
9.0V	744
12.0V	1032
15.0V	1320
18.0V	1608

The voltage selection from the computer is achieved using a 4-bit binary code. This is decoded by IC4 (74LS154) and inverted by IC2 or IC3 (74LS240), before enabling one of the 16 transistors TR1 - TR16 (BC337). The transistor connects its particular resistor divider to ground (e.g. TR1 connects R1/RV1), hence selecting the required voltage. The 4-bit binary code can be generated from any 4-bit or 8-bit com-

puter port — available on most computers (e.g. parallel printer port).

The +5V supply for IC2-IC4 is provided by IC5 (LM7805), a +5V regulator. Both voltage regulators must be mounted on heatsinks, especially IC1 as it may be supplying a fairly large current.

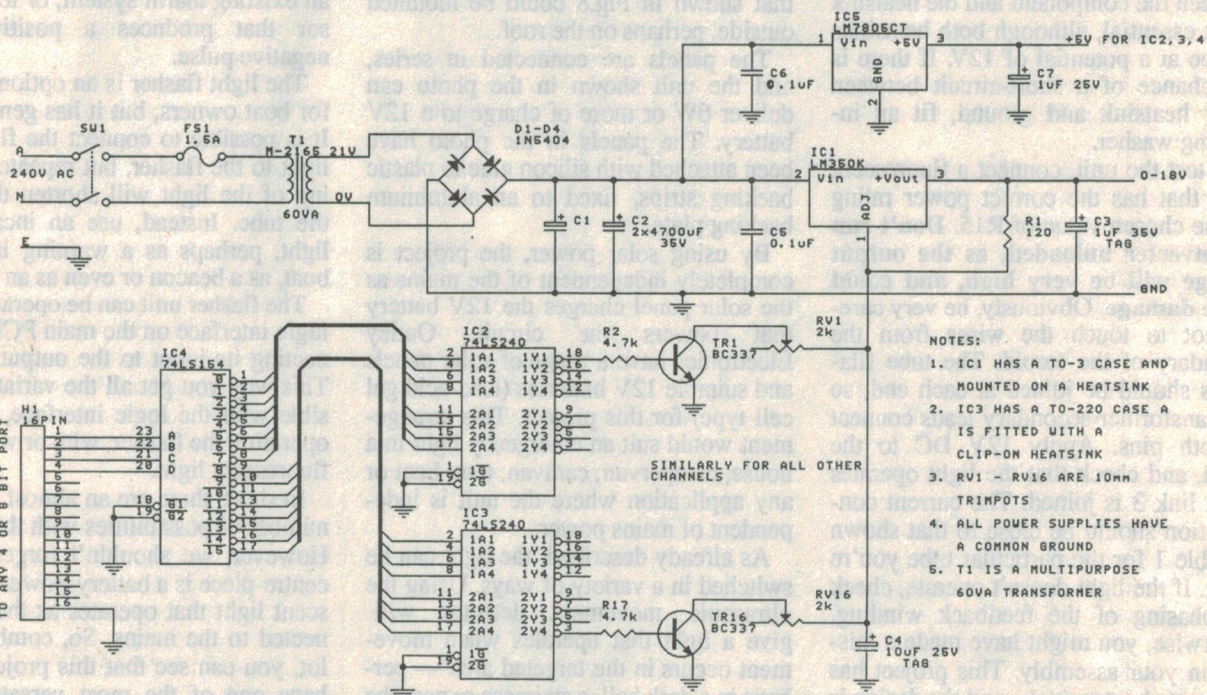
The calibration procedure is very simple. Program the computer to send out each of the 4-bit codes in turn, and for each code adjust the relevant trimpot, RV1-RV16, while measuring the output voltage. Once the output voltage has been set and the voltage recorded, move on to the next code. Alternatively, each of transistors could be biased on in turn, by connecting their bases — via a suitable resistor — to the +5V rail. IC2 and IC3 would preferably not be connected at this stage. After setting the output voltages, the software control would then be developed.

Finally, for greater accuracy, 10-turn cermet trimpots may be used and LED indicators for the channel selected can also be added. But these improvements will of course add to the total cost of the project.

Alfred Fong,

Carlingford, NSW

\$45



NOTES:

1. IC1 HAS A TO-3 CASE AND MOUNTED ON A HEATSINK
2. IC3 HAS A TO-220 CASE A IS FITTED WITH A CLIP-ON HEATSINK
3. RV1 - RV16 ARE 10mm TRIMPOTS
4. ALL POWER SUPPLIES HAVE A COMMON GROUND
5. T1 IS A MULTIPURPOSE 60VA TRANSFORMER

Apple II robot controller

This circuit was designed to control robotic machines via an Apple II computer. As shown, it controls the up and down motion of an opening bridge, by using two annunciator outputs on the Game I/O connector to drive the motor in each direction, and one input to switch off when the bridge has returned to its closed position. The listing of a sample program in Applesoft BASIC is provided.

The two annunciator outputs (Ann.0 and Ann.1) drive two optocouplers (4N28) which isolate the computer from the separately powered motor drive circuit. When activated, each of the optocouplers biases on a BC548 transistor (Q1 - Q2), which in turn switches on a pair of power transistors (TIP31).

Ann.0 turns on Q1 which switches on transistors Q3 and Q6 for the forward motion of the motor, while Ann.1 switches on Q5 and Q4, via Q2, for the reverse motion. Two LEDs are attached, one to either side of the motor, to display the motor direction.

The 'stop' signal is sent via pushbutton PB which is connected to the one-bit (pushbutton) input PB2. (Input PB2 has been used, since PB0 and PB1 are normally used by your joystick and paddles.)

The Apple annunciators are controlled by a 'soft switch', each of which is assigned a pair of addresses. If you reference the first address in the pair, you turn the annunciator 'off' (0V), and if you reference the second, you turn it on (+5V).

For more complex control than the circuit given, there are a total of four annunciators, Ann.0 - Ann.3, with control addresses from -16296 to -16289. Their outputs are taken from pins 15 - 12 on the I/O connector.

The three one-bit inputs (PB0-PB2) mentioned above are available on pins 2 - 4 of the connector. They are standard

```
10 REM Bridge control
20 HOME: REM Clear screen
30 REM address locations
40 PB=-16285: A0=-16296:
A1=-16294
50 REM up and pause times
60 UP=3000: WA=7000
70 REM Wait for keypress
80 PRINT "Press any key to start ";
90 GET AS: PRINT
100 REM up movement
110 GOSUB 190: FOR I=1 TO UP:
NEXT I
120 REM stop and pause
130 GOSUB 210: FOR I=1 TO
WA: NEXT I
140 REM down movement
150 GOSUB 230
160 REM reached bottom (N,Y)?
170 IF PEEK(PB)<128 THEN 170
180 GOSUB 210: GOTO 10
190 REM up: A0 on, A1 off
200 X=PEEK(A0+1):
X=PEEK(A1): RETURN
210 REM stop: A0, A1 off
220 X=PEEK(A0): X=PEEK
(A1): RETURN
230 REM down: A0 off, A1 on
240 X=PEEK(A0):
X=PEEK(A1+1): RETURN
```

74LS series TTL inputs, and their addresses are -16287 to -16285.

Also available are four analog inputs, called 'game controller inputs' (GC0-GC3), connected to pins 6, 7, 10 and 11. Designed to be connected through a 150k variable resistor to +5V, they can be used for components like LDRs and thermistors.

Shane Hoyle,
Mossman, Qld

\$40

PC-BASED CIRCUIT SIMULATORS

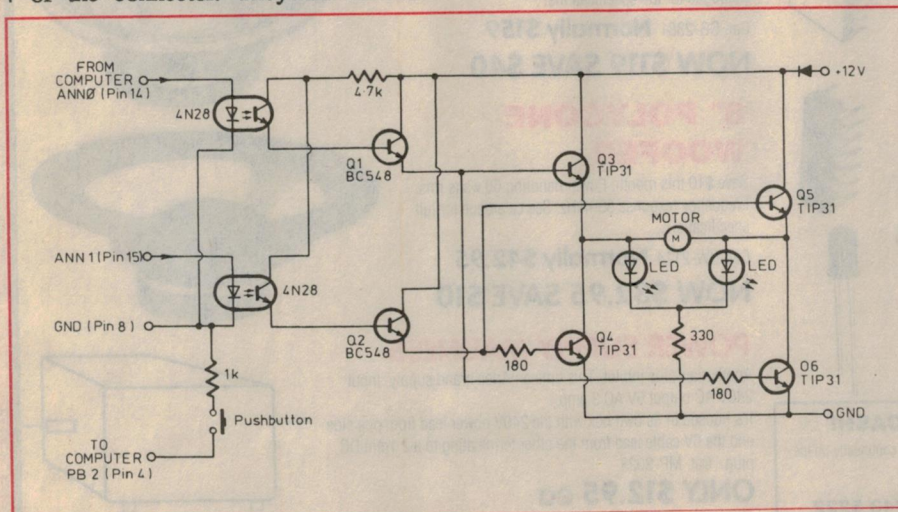
An Introduction

Computer programs capable of simulating the performance of complex analog circuits can now be run on many personal computers, heralding a new era in the design of electronic equipment. In the future, much of the tedious design hack-work will be performed on a PC, providing faster and more accurate results than bench testing.

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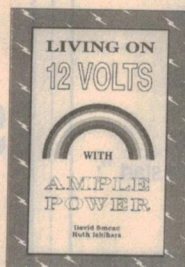


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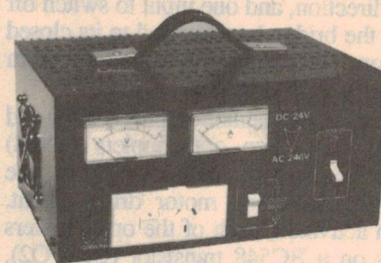
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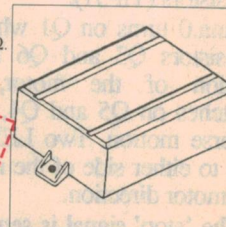
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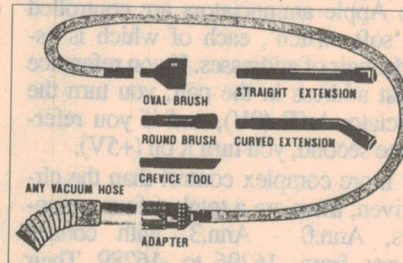


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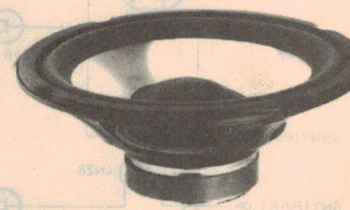


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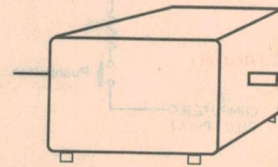
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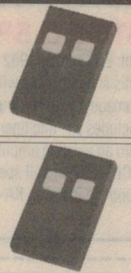
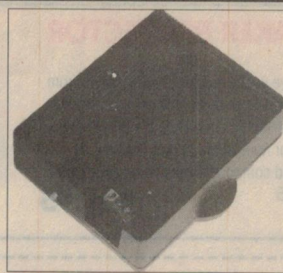
The keyfobs have two buttons on them, one LOCK and one UNLOCK with a LED to show unit has transmitted. Size is normal keyfob size 60 x 35 x 14mm and has a keyring.

The Receiver

It's a black box with a 4 way terminal block for external connections. These are for +12V, -12V, LOCK and UNLOCK.

Features

There are separate outputs for lock and unlock which are both momentary (approx 0.5 seconds). There are two separate relays, one for lock and the other for unlock, which will switch currents up to 2 amps which is adequate for most applications. There is also a switch which allows the output relays to switch either to



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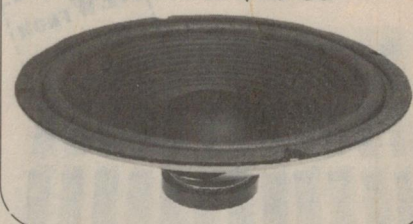
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Sensitivity	87dB 1W 1m
Magnet Weight	190 grams
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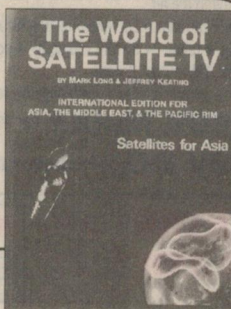
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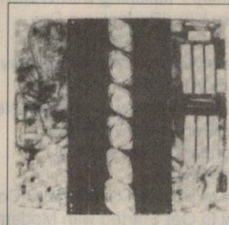
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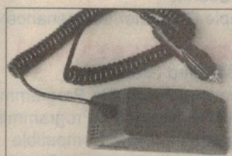
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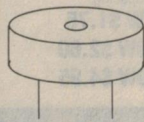
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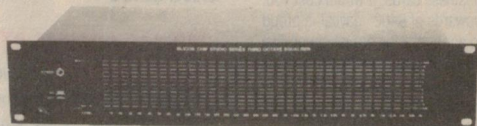
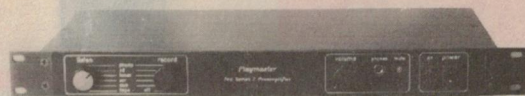
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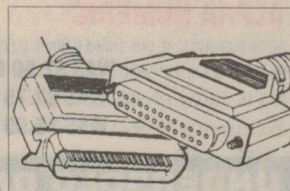
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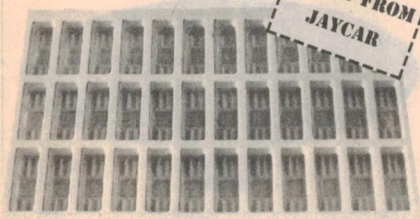


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Ref: EA October 1992

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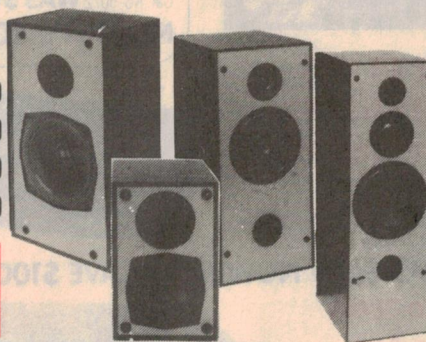
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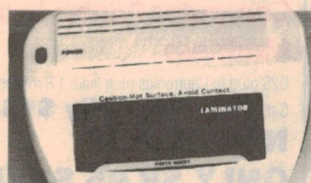
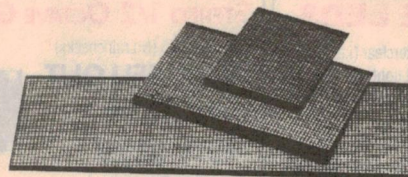
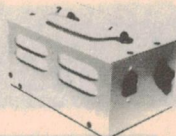


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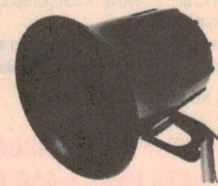
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Ref: Silicon Chip May 1990

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WAS \$109 NOW ONLY \$89 SAVE A HUGE \$20



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Cat. MB-3503

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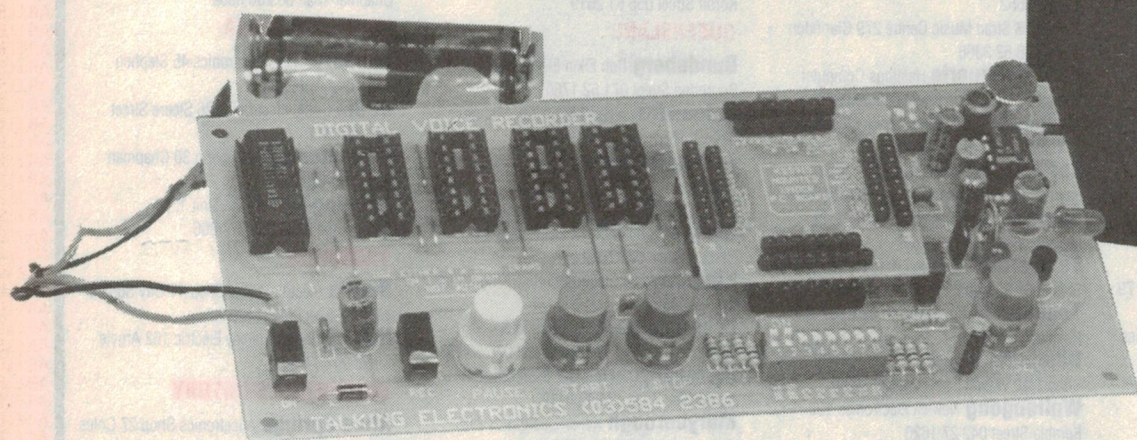
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Construction Project:

Low cost Digital Voice Recorder



Here is an experimental project — a 'no moving parts' digital audio recorder which can record and play back up to 512 seconds of speech, in as many as 16 different messages. It's based on a special 60-pin surface mount chip, from Samsung.

by COLIN MITCHELL

To a skeptical realist, this project uses a million transistors to store and retrieve a 30-second message. To an economist, it's the equivalent of a \$14.95 tape recorder — costing \$85.00! But to an electronics person, it's a miracle of solid state technology.

I hope you are the latter. For about \$65 - \$85, you can get about eight minutes of tape-recorder quality speech, without the need for any tape, pulleys, motors or other mechanics.

And when you do away with mechanics, you increase the reliability enormously. You eliminate tape breakage, jamming, wow and flutter, sound degradation and all those troubles that haunt mechanical transport mechanisms.

But it hasn't been easy. The complexity of creating electronic speech has always been very expensive. That's because there's an enormous amount of memory required to store even the shortest message. Because of this, digitally recorded speech has failed to

take over from mechanical systems, in the past. But this has now changed. With the introduction of Samsung's digital voice chip KS5915, we can produce a low-cost system using just two chips and an audio amplifier.

In this project we have provided an experimental board for the KS5915, so you can see how it works. The boards also let you use some of your old

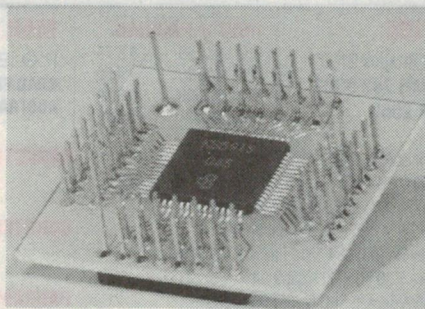
256Kb RAM chips, such as 41256, for the memory.

Anyone who has upgraded their computer in the past few years will probably have a handful of 256Kb chips in their junk box. If you don't, I'm sure you will know someone who will be only too glad to give you some and this will make the project even cheaper. That's why we have priced things separately, at the end of the article.

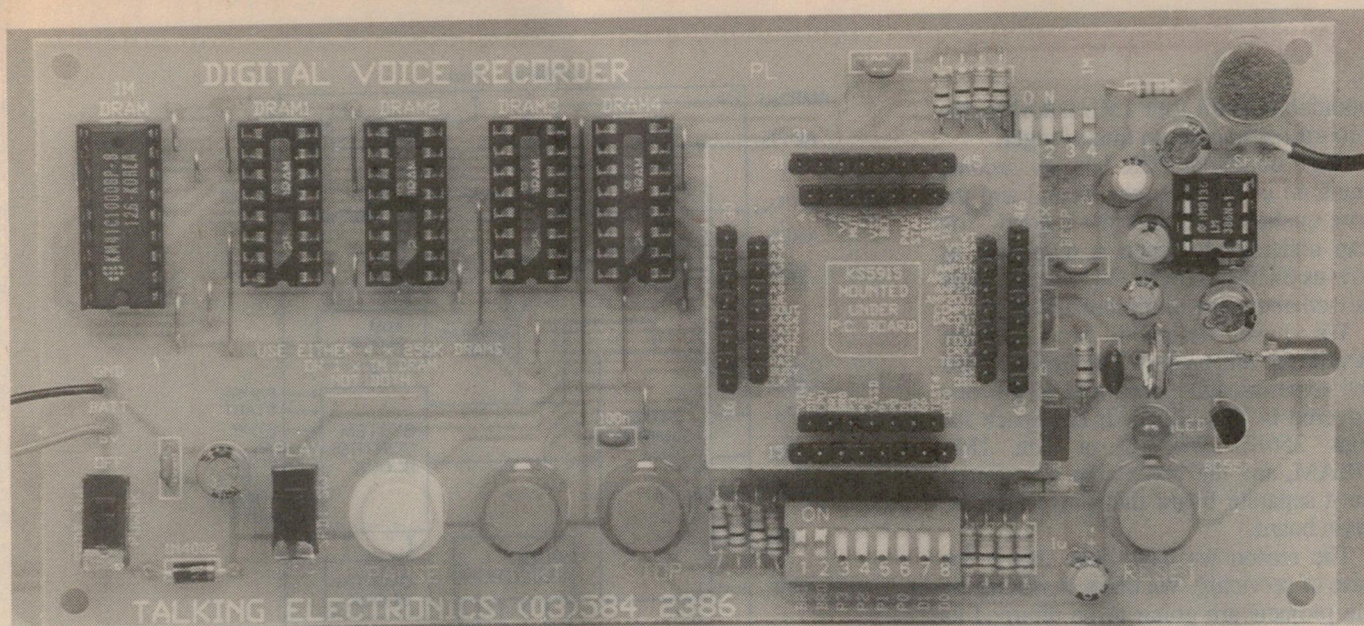
The board comes with one 1Mb DRAM and if you want more memory, you will need to go for our other board, DVR #2, as listed at the end of the article. It must be noted that the voice chip will not take a mixture of 1Mb and 256Kb RAMs. You must only use one type — and a maximum of four chips can be accessed.

However the capabilities of the chip are amazing and to put it mildly, it's the answer to many an engineer's dream.

For about \$15, the main chip offers the potential to add speech to a multitude of projects such as alarms,



Here is the 'daughter' PCB itself, turned upside down to show the surface mount KS5915 chip.



Apart from the speaker and battery, all of the components for the digital recorder fit on a single PC board — shown here a little larger than actual size. The KS5915 chip itself is mounted on the underside of the small square 'daughter' PCB.

aids for the handicapped, warning systems and the like.

Speech quality

As far as I am concerned, this project offers the best quality 'digital' speech to date. I have tried the SC-01, SP0256-AL2 and they both had one disadvantage: the listener could not understand the phoneme speech.

It was too robotised. There were not enough phonemes, or enough inflexion, to allow the programmer to produce realistic speech; so you got a result such as 'Tawking Electronix'.

It was only after the listener was told what was being said that they understood it — and even then with some hesitation.

We designed a speech board for the handicapped, using the SP0256. But at a trial run, sentences such as 'I want a cup of tea' or 'I want to go outside' could not be understood by the nurses, and the project had to be scrapped.

But with the Samsung KS5915 the output is a real voice, not computer generated phonemes. You can record words, phrases and sentences as clear as a normal human voice, so that the listener doesn't have to strain to interpret what is being said.

16 messages

The chip has a very clever feature that divides the memory into 16 segments. This allows you to store up to 16 separate words or phrases, which can be replayed in any order.

Each phrase can be any length, as the chip remembers the start and end

address. Provided the total time is within the memory of the RAM chips, they can be called up in any order and used in many ways.

By setting pins 6, 7, 9 and 10 either high or low, a particular phrase can be recorded onto memory. These pins have been taken to the 8-way DIP switch as P0, P1, P2 and P3, and are accessed in a binary fashion as detailed in the main table.

The KS5915 can access one, two,

three or four 256Kb DRAM chips, or the same number of 1Mb DRAMs. If you are designing a new system, it is advisable to use 1Mb DRAMs, as the cost is now more than comparable with 256Kb devices and the recording time is four times longer.

A 1Mb DRAM can provide 32 seconds of high quality speech, or 64 seconds at medium quality or 128 seconds of lower quality — but even then the output is still perfectly under-

PARTS LIST

Resistors

- 1 330 ohms
- 1 1.2k
- 13 10k
- 1 22k

Capacitors

- 2 27pF ceramic
- 1 10nF metallised polyester
- 5 0.1uF (100nF) monolithic
- 3 1uF 25VW electrolytic
- 1 10uF 16VW electrolytic
- 3 100uF 16VW electrolytic

Semiconductors

- 1 LM386N-1 audio amplifier
- 1 41C1000 1M DRAM
- 1 KS5915 voice chip soldered onto daughter PC board
- 1 BC557 PNP transistor
- 1 1N4002 diode
- 1 3mm red LED
- 1 5mm LED (for 'knob' on pot)

Miscellaneous

- 1 640kHz resonator
- 1 10k mini trimpot
- 1 Electret mic insert
- 1 8-ohm speaker
- 1 4-way DIP switch
- 1 8-way DIP switch

- 1 8-pin IC socket
- 4 16-pin IC sockets
- 1 18-pin IC socket
- 4 Push buttons, PCB mount (4 colours)
- 2 SPDT mini slide switches, PCB mount
- 60 PCB pins for daughter board
- 60 PCB pin sockets
- (2 x 14-pin, 2 x 16-pin IC sockets)
- 1 Battery snap lead
- 1 Battery holder, four AA cell type
- 4 AA alkaline cells
- 1 30cm length tinned copper wire
- 2 10cm length hook-up wire for speaker
- 1 Digital Voice #1 PC board

NOTE:Kits for the Digital Voice Recorder are available from:

Talking Electronics,
35 Rosewarne Avenue,
Cheltenham, Vic 3192
Phone (03) 584 2386

- DVR #1 kit and PC (as described) \$85.00
- DVR #1 built and tested \$115.00
- DVR #2 kit and PC (for PC control) \$65.00
- DVR #2 built and tested \$100.00

All of the above come with 1Mb DRAM. Extra DRAMs are available for \$11.00 each. Pack and postage for any kit adds \$4.50.

A repair service is available, from Talking Electronics only. Start by sending in the daughter board for checking.

Voice Recorder

standable. With four 1Mb DRAMs, the recording time is four times longer.

High quality is 32K bits per second, medium is 16K bits per second and the low quality is 8K bits per second. You can understand speech at a bit rate as low as 6Kbps, so even the lowest bit rate is well above the minimum necessary.

We have designed two different boards for this project. The first is called the experimental board and is the one covered in this article. It has space for four 256Kb DRAMs or one 1Mb DRAM, and the voice chip is mounted on a separate board that plugs into the main board.

The reason we have done this is for ease of servicing. We know that some of the projects are going to be returned to us for servicing and to make our job easier we have decided to put the voice chip on a separate board. This will allow us to test it separately. This will assist you too, as you can send the plug-in board to us for testing.

If the chip is damaged for any reason, we will not be removing it and fitting a new one, but will simply supply you with a new board with the chip already soldered in position. We have done it this way so you are guaranteed to get the project working. The difficulty in servicing a 60 pin surface-mount chip is greater than you think.

Since a carrier for the chip is very expensive, ours is the cheapest and best way to go. Once you know the voice chip board works perfectly, you can work on shorts and faults in the memory section.

The other board, (DVR#2), is for specific applications and is designed to be controlled by a computer. It has provision for four 1Mb DRAMs.

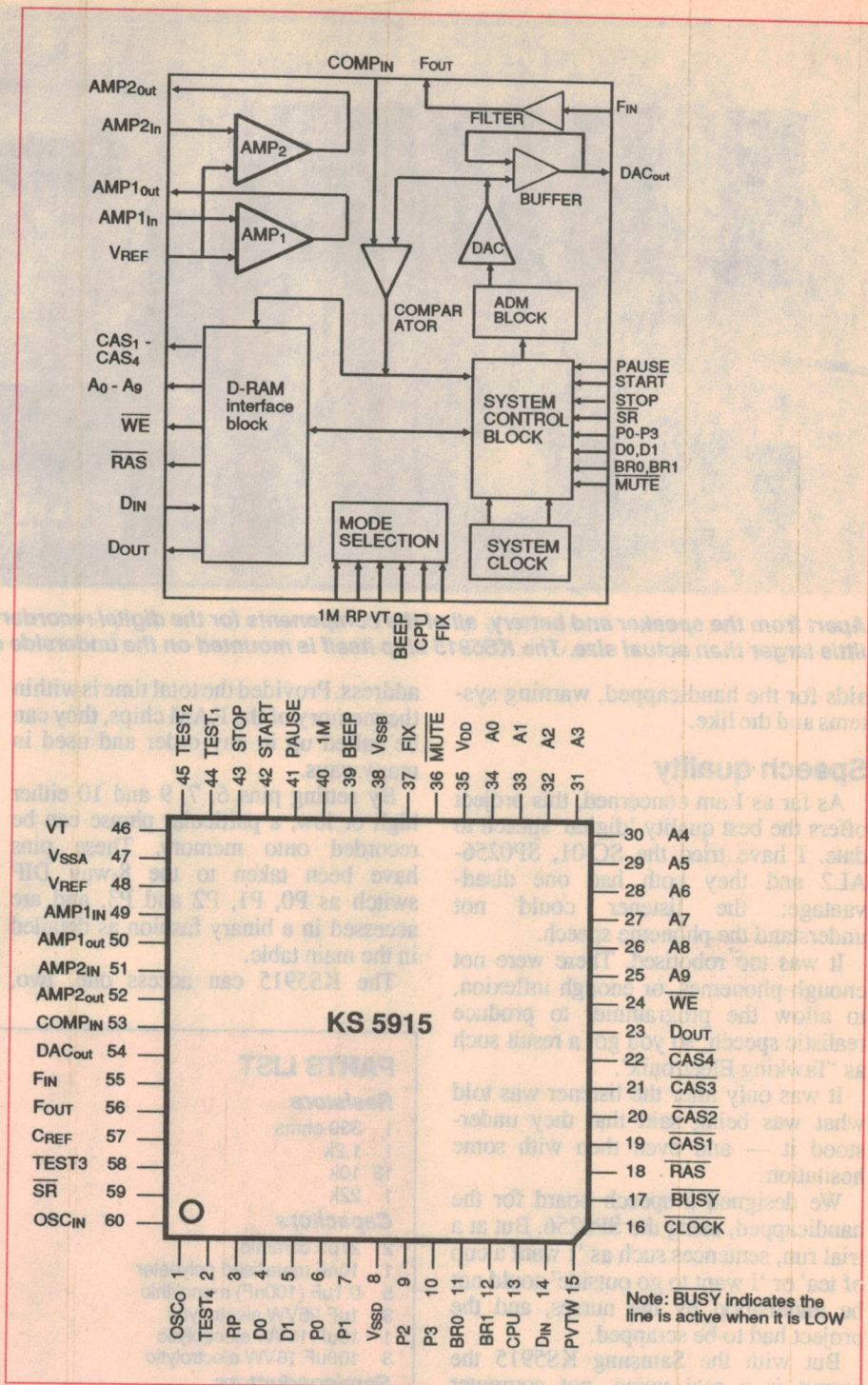
The voice chip is soldered directly to the board (there is no daughter board) and the constructor is expected to be good at soldering and diagnosis, as we will not be providing a low-cost repair service.

How it works

The KS5915 voice recording chip uses the Adaptive Delta Modulation (ADM) method — see Fig.1.

The audio from the electret microphone is passed to an audio amplifier within the chip and then to a comparator. This comparator is controlled by the ADM block to produce a 1-bit data stream, for storing the information in RAM.

The sampling rate is determined by



Here is an internal block diagram for the KS5915 chip, together with a diagram showing the function performed by each of its 60 pins. Use these in conjunction with the table opposite, in understanding the chip's operation.

the bit-rate oscillator and this can be one of four rates. The lowest rate provides fair quality sound and the longest recording time, whereas the fastest bit rate provides tape-recorder quality but with the shortest recording time.

No matter what size memory you use, there is always a trade-off between sound quality and recording time. When the signal is played back, it is clocked

out of memory and through a 10-bit digital-to-analog converter (DAC).

The signal is then buffered and filtered within the chip and passed to an LM386 audio amplifier chip, to drive a small speaker. The result is exactly like having a miniature tape recorder you can use for such things as messages, emergency information, notes or getting your cocky to talk correctly.

PIN FUNCTIONS FOR KS5915 VOICE CHIP

Pin No: Name: IN/OUT Pull up/down Description:

1	OSCOUT	OUT	—	Oscillator output terminal						
2	TEST4	OUT		For Test purposes						
3	RP	IN		H: Recording Mode L: Reproducing Mode						
4	D0			Programming for number of D-RAMS:						
5	D1			1: 4-L 5-L 2: 4-L 5-H 3: 4-H 5-L 4: 4-H 5-H						
6	P0		Down	Programming for Phrase selection						
7	P1		Down	Phrase No. P0 P1 P2 P3						
9	P2		Down	0 0 0 0 0						
10	P3		Down	1 0 0 0 1						
8	VSSD	Power	—	Digital Ground						
11	BR0	IN	Down	Bit Rate Selection:						
12	BR1	IN	Down	8K: 11-L 12-L 16K: 11-L 12-H 22K: 11-H 12-L 32K: 11-H 12-H						
13	CPU	IN	Down	Determines debounce time H=16u sec L=16msec						
14	DIN	IN	Up	Receives data from D-RAM (data input pin)						
15	PVTW	OUT	—	Generally H during pause or voice trigger waiting condition						
16	CLOCK	OUT	—	For test						
17	BUSY	OUT	—	Generates L during recording or playing						
18	RAS	OUT	—	Row address strobe						
19	CAS1	OUT	—	Column Address Strobe						
20	CAS2	OUT	—							
21	CAS3	OUT	—							
22	CAS4	OUT	—							
23	DOUT	OUT	—	Delivers Data to D-RAM						
24	WE	OUT	—	Enables D-RAM address						
25: A9	26: A8	27: A7	28: A6	29: A5	30: A4	31: A3	32: A2	33: A1	34: A0	D-RAM Address
35	VDD	Power	—	+5v supply						
36	MUTE	IN	Down	L: Mute during recording H: No mute during recording						
37	FIX	IN	Down	L: Variable phrase mode with 256k H: Fixed phrase mode with 256k						
38	VSSB	Power	—	ground						
39	BEEP	IN	Down	L: Not in beep mode H: In beep mode						
40	1M	IN	—	L: 256k D-RAM accessed H: 1M D-RAM accessed						
41	PAUSE	IN	Down	PAUSE and PAUSE RELEASE via short pulse						
42	START	IN	Down	START via brief pulse						
43	STOP	IN	Down	STOP via brief pulse						
44	TEST1	IN	Down	For Test purposes						
45	TEST2	IN	Down	For Test purposes						
46	VT	IN	Down	L: Not in Voice Trigger Mode H: In Voice Trigger Mode						
47	VSSA	Power	—	Analog ground						
48	VREF	IN/OUT	—	Stabilizes reference voltage of amp (0.1uF cap)						
49	AMP1 IN	IN	—	Input terminal of amplifier 1						
50	AMP1 OUT	OUT	—	Output terminal of amplifier 1 (26dB)						
51	AMP2 IN	IN	—	Input terminal of amplifier 2						
52	AMP2 OUT	OUT	—	Output terminal of amplifier 2 (20dB)						
53	COMPI	IN	—	Input of comparator (signals over 2.5v ±1.25v are saturated)						
54	DAC0	OUT	—	DAC output terminal						
55	FIN	IN	—	Input terminal of filter						
56	FOUT	OUT	—	Output terminal of filter						
57	CREF	IN/OUT	—	Stabilises reference voltage of filter (0.1uF)						
58	TEST3	IN	Down	For test purposes						
59	SR	IN	Up	System reset terminal (requires 1uF cap)						
60	OSCIN	IN	—	Oscillator Input terminal						

The function of each of the voice chip's 60 pins is shown in this table. Note that it can be programmed to use either 1M or 256K DRAM chips, and from one to four of either kind. It can also sample at one of four different bit rates.

Assembly

The kit comes with a 1Mb DRAM chip and all components including pins and sockets for the daughter board. The KS5915 voice chip is supplied already soldered to a small board, which plugs

directly into the main board. The most important thing you will have to remember at the end of construction is to plug this board in correctly, so that the chip is not damaged when power is applied.

We have taken particular care to prevent you making a mistake by show-

ing the outline of the chip on both boards. Notice one of the corners is cut off the chip.

This corner does not correspond to pin 1 and that's why you have to be so careful. The small board also has a pin that must align with a hole in the other board, so that the two can be plugged together correctly.

All these things have been done to prevent a disaster, as we ourselves damaged three chips before our assembler realised that pin 1 is not at the cut corner.

Assembly of the small board is straightforward as the surface-mount chip has already been soldered for you and all you have to do is solder 60 pins to the lands. This is made easier as they come in moulded 'header' strips.

If you buy the expanded memory version (DVR #2), you will have to fit the voice chip yourself and this will require a very fine soldering iron and fine solder. Here it is important to align the chip so that the pins on all four sides align with the lands on the board. Make sure the cut corner on the chip matches with the outline on the board. Solder the diagonally opposite pins to hold the chip in place then work your way around the four sides.

Use a piece of desolder braid to remove any surplus solder, so that only the minimum of solder is used to make the connection. When you have finished, hold the board up to the light so that you can see through the pins and look for any shorts or bridges.

Even the finest hair of solder will prevent the chip from working and may cause damage, so take special care. If you are not sure, you can take a multi-meter set to low ohms and check for shorts between pins.

Back to the board for this project. The first job is to fit the 60 pins to the daughter board. This board will be placed on top of the main board so that the writing is on the top side (The KS5915 chip will be on the underside). This means the pins must be soldered to the track side, so that the board plugs in correctly.

This is a little difficult to do as you must push them through the holes so that the plastic spacer (joining the pins) does not touch the solder lands. This will give you room to get the soldering iron onto the land to make the connection. Solder all the pins and the board is complete.

Next, the sockets for the daughter board are soldered to the main board. These come in the form of 2 x 14-pin IC sockets and 2 x 16-pin IC sockets. The sockets must be cut apart with side-cut-

Voice Recorder

ters to make separate lengths of 7-pin and 8-pin socket strip.

All the remaining parts are straightforward. It is best to fit the links first, as they are the closest to the board and easiest to fit when the board is bare.

The sockets for the ordinary IC's have a cut-out at one end, which matches with the outline on the board. This helps you fit the IC's around the correct way, when it comes time to fit them at the end.

The electrolytics, diode, LED, transistor and electret microphone must be fitted around the correct way too. The four push-switches have a flat on one

side and they must be fitted to match with the PCB overlay. The 4-way and 8-way DIP switches are fitted so that the 'ON' position is UP, when the PCB is viewed with the microphone at top right.

Finally, you can fit the two small slide switches, five 0.1uF monolithic capacitors (100n monoblocks), two ceramic capacitors, mini trimpot, resistors, 10nF greencap, 640kHz resonator and speaker to the board.

The resonator is very delicate and the pins must not be moved or bent, as this will upset the contacts inside the resonator. We had trouble with one kit due to the resonator being bent over slightly after soldering, so make sure no strain is placed on the leads.

All that is left to do is plug in the daughter board containing the voice chip (making SURE it's the right way around), a 1Mb DRAM (or four 256Kb DRAMs) and the LM386 audio chip. Then you can connect a battery snap and four alkaline cells, to make a 6V supply.

Do not use anything else for powering the project, as the voltage to the chips must not be higher than 5.5V and the diode in series with the positive line drops the 6V supply to 5.4V.

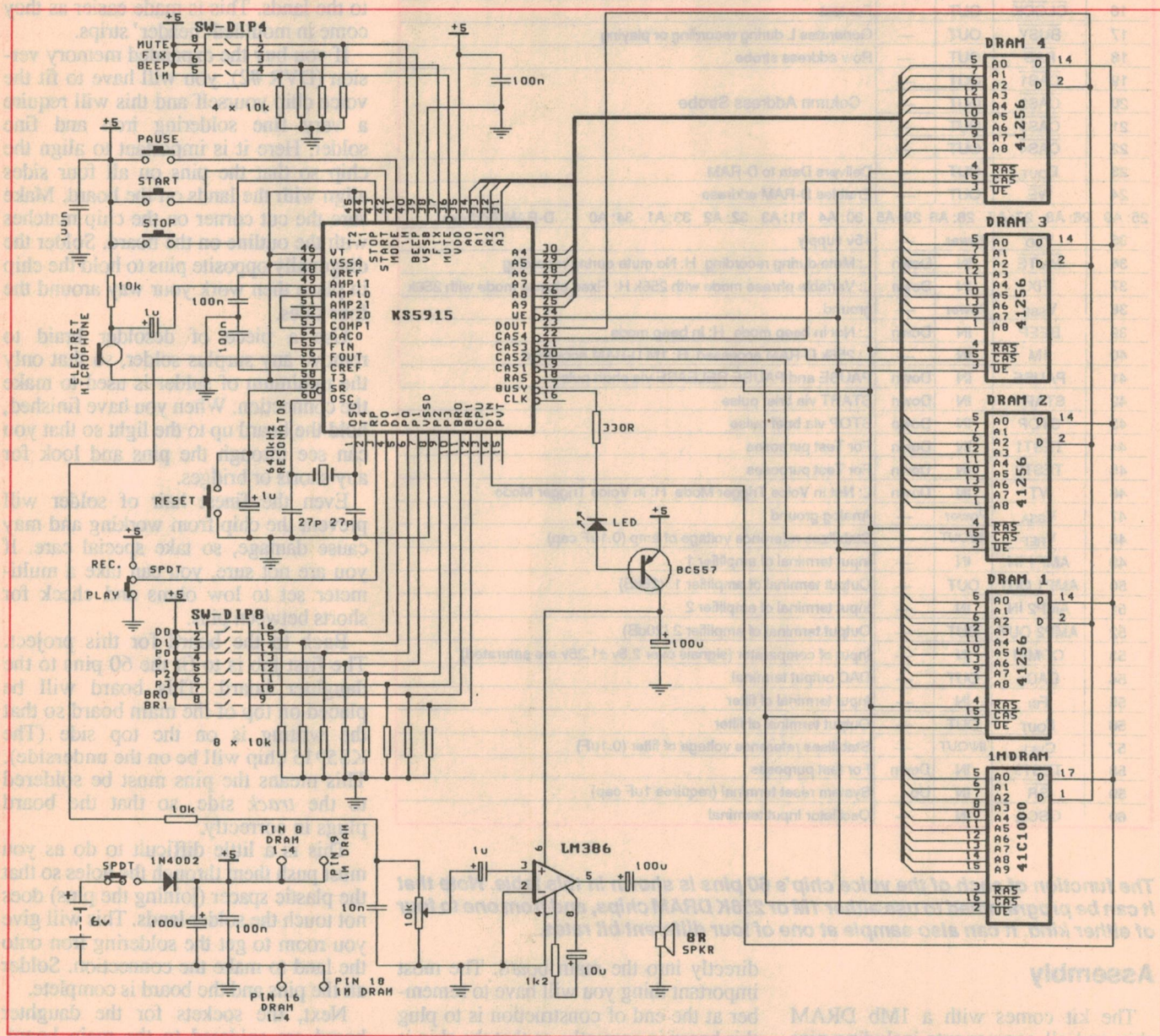
If you have fitted a 1Mb DRAM, set the DIP switches as follows:

4-way DIP:

1-OFF 2-OFF 3-OFF 4-ON

8-way DIP:

1-ON 2-ON (3-8: OFF)



Fairly obviously, this is the schematic for the digital recorder. All of the critical functions are performed by the Samsung KS5915 speech recording chip, while either a single 1M or up to four 256K DRAM chips are used to store the sampled audio. The LM386 chip is used to feed the replay audio to a small eight ohm speaker.

Turn the power switch ON (you should paint a red mark to indicate the ON position) and the PLAY/RECORD switch to REC. Push the start button and the LED will come on.

Repeat function

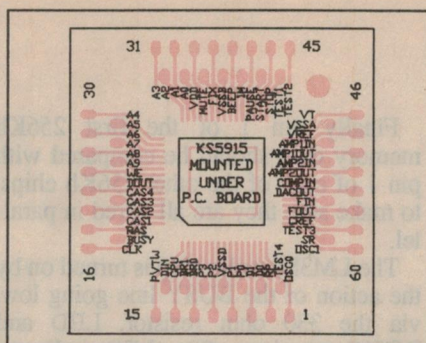
One of the features of the KS5915 chip is the repeat function. This can be done by connecting the output of the BUSY line (pin 17) to the START (pin 42) via a resistor such as 10k (for short-circuit protection), with a slide switch in series.

We will call this the LOOP SWITCH. This will allow the message to be repeated *ad infinitum*. To create a loop, you can use one, two, three or four 256Kb DRAMs or a 1M DRAM; you can also adjust the bit rate.

To record on the loop, slide the LOOP SWITCH to the off position and record the message. Slide the LOOP SWITCH to the ON position and the loop message will repeat continually. The STOP button in this mode will act as a RESTART and the PAUSE will toggle STOP/ START.

If you want the loop to start from the beginning via a push button, you will need some form of latching such as a latching relay, in place of the Loop Switch.

There is a whole range of possibilities with this chip, and you can try your own



The main point to note about the 'daughter' PCB is that the locating pin is at the opposite corner to the chamfered corner of the chip.

ideas once you have the project up and running.

It doesn't work?

If the project doesn't work, you have a challenge in store. The most likely cause will be faulty soldering, a component around the wrong way, the wrong value or something missing from the board.

Make sure all the links have been fitted and re-check the soldering to all pins. This accounts for the majority of projects we get in for repair. Quite often the customer says he has 'spent hours' looking for the fault and when he sends the project in, one of the leads of a component has never been soldered! It can be as easy as that.

It is almost impossible to check your own work, so give it to someone else to check. Ask them to look for any shorts between tracks, especially in the memory section, where the tracks are very close.

A very good aid to help in locating

hairline bridges and dry joints is a magnifying glass. These can be purchased on a PC board stand that will allow you to hold the board while soldering, so that the section being worked on is magnified.

At this point you will appreciate the Voice chip mounted on a separate board. If you are having problems getting the project to work, you can send the daughter board (or the whole project) to us (Talking Electronics) for testing and service.

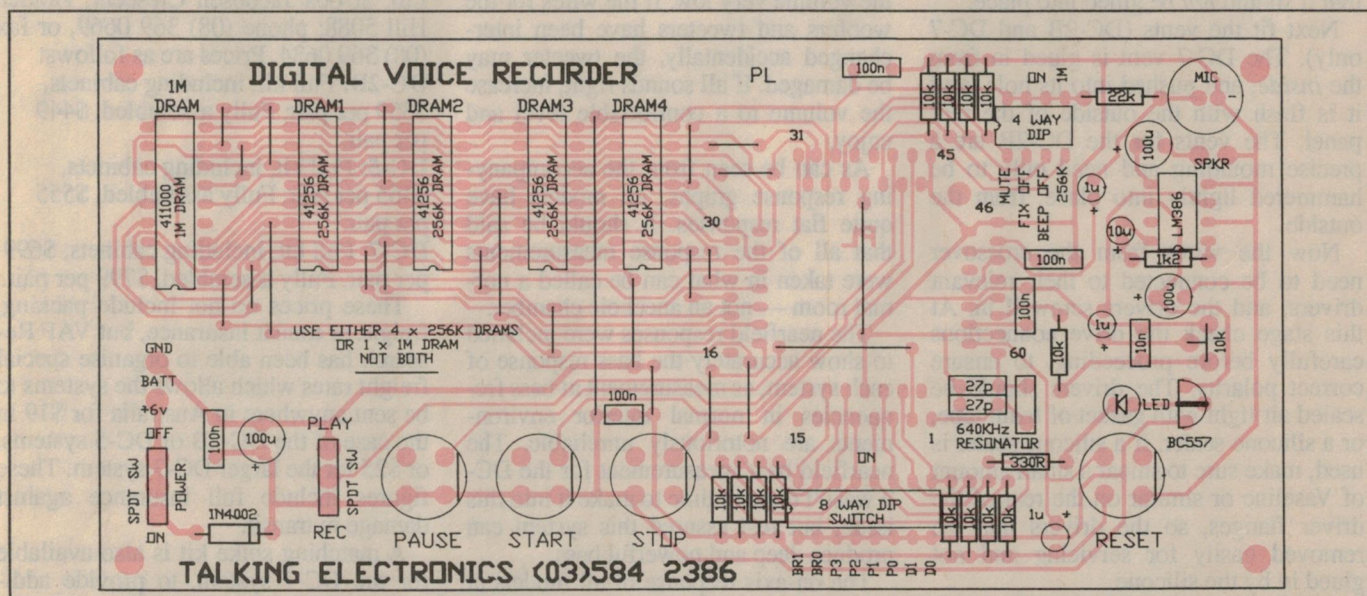
We will replace the daughter board for \$25 and/or service the main board for \$15 plus parts. If you bring the daughter board to us we will test it free and this will eliminate half the problem.

The best way to tackle the rest of the circuit is to make up another board and plug in the voice section. Alternatively you can buy a ready-made unit and compare the voltages and signals with your non-working model. The most important thing is not to allow the problem to beat you.

To help you, here's some more information:

Check the current on stand-by. It should be about 4-5mA. During record mode the current rises to 15mA, while during playback the current is basically 15mA and rises during loud sound passages. The stand-by current will depend on the number of memory chips and the type of chips you have used, so don't worry about exact values.

If you are not getting readings close to ours, home-in on the problem by removing the chips, one at a time. If the current is more than 100 milliamps, you can be sure there's a short-circuit or a low-resis-



Here is the PCB overlay diagram for the main recorder board, showing where everything goes.

Voice Recorder

tance component such as the wrong value resistor or a leaky electrolytic (probably reverse connected).

To locate a short, you will need to cut the positive rail at various points on the board to isolate part of the circuit. When the current is correct, check the components that have been isolated and replace them one at a time.

Next, concentrate on the DC voltage levels on the input pins of the voice chip, as these must be correct so that it selects the type of RAM and the number of RAMs in use.

Do not combine 256Kb DRAMs and 1Mb DRAMs, and do not mix RAMs with different markings and speeds. You may be able to use them later, but when trying to get a project working, keep the problems to a minimum.

Next you will need a continuity tester to check all the data and address lines in the memory section. Remove the memory chips and check each pin against all the other pins.

None of the pins should short together and if the continuity tester beeps, check the board to see why.

Finally pin 1 of the first 256Kb memory chip should be compared with pin 1 of each of the other 256Kb chips, to make sure they are all wired in parallel.

The LM386 audio chip is turned on by the action of the BUSY line going low, via the 330 ohm resistor, LED and BC557 transistor. The LED indicates when the BUSY line is low and thus when the audio amplifier should be operating. If there's no audio and the LED doesn't glow, make sure the LED is not around the wrong way.

Turn the volume control to mid position during testing, so that it will deliver audio to the speaker.

One possible fault is the lack of audio after a recording has been made. To home-in on the fault, turn the beep ON and if the 'end of message beep' occurs soon after the start button has been pressed, it will indicate that data has not been stored in the RAM chips.

Armed with the above information, you should be able to get your DVR working. I'm sure you will be impressed with the quality of reproduction.

Possible uses

The possibilities for this project are limitless. You could make it turn on when movement is detected, when a button is pressed or when a pressure mat is activated. It can be added to machinery, to assist the operator in diagnosing a fault, or connected to a car to alert the driver if some of the seatbelts have not been fastened.

It is also ideal for providing information in lifts, or emergency situations such as fires etc. In fact it can be used for almost any type of recorded information, including 'auction boards' on houses, (where you tune into the FM band as you sit outside the house and listen to a short description of the features of the house); for road and flood alerts (again, via an FM broadcast); animated displays at a fair or museum; and lots more.

With this project you have the basics for some great new ideas and inventions — so why not see what you can come up with? Maybe you can produce something that will turn into a successful business venture. Let's hope so. ♦

New speaker kits reflect fresh thinking

Continued from page 41
rect polarity, and if everything is OK the terminals are then screwed into place.

The special 'hypersoft' foam is then fitted as mentioned earlier, directly behind the drivers in the space between the brace and the front panel. Remember that it should *not* be glued into place.

Next fit the vents (DC-2B and DC-7 only). The DC-7 vent is glued in from the *inside*, and pushed into its hole until it is flush with the outside of the rear panel. The vents for the DC-2B are a precise moulding and need only to be hammered lightly into place, from the outside.

Now the wires from the crossover need to be connected to their relevant drivers, and the drivers screwed in. At this stage check the drive connections carefully before proceeding, to ensure correct polarity. The drivers should be sealed air tight with gasket of foam tape, or a silicone sealer. If a silicone sealer is used, make sure to smear a small amount of Vaseline or similar on the rear of the driver flanges, so the drivers may be removed easily for servicing and not glued in by the silicone.

Finally press in the grille clips, and you're finished. For those readers unable

or unwilling to assemble the kits themselves, all three systems are available fully assembled and tested for a small extra charge.

Listening

When turning on for the first time, set the volume very low. If the wires for the woofers and tweeters have been interchanged accidentally, the tweeter may be damaged. If all sounds right, increase the volume to a comfortable level and enjoy.

As can be seen from the accompanying response graphs, all models have quite flat responses. It should be said that all of the response measurements were taken in what can be called a normal room — not an anechoic chamber.

The nearfield responses were included to show accurately the bass response of each system, as measurement at bass frequencies in normal interior environments are notoriously unreliable. The nearfield bass measurement for the DC-7 wasn't done in time to make it into this issue, but rest assured this system can produce deep and powerful bass.

The on-axis response of all models at most frequencies falls within ± 2 dB. The DC-2B's show two minor depres-

sions in the midrange, but these are very narrow and are not very deep. Although not shown, plots of the response at 45° below axis verify that there is no excessive energy directed toward the floor.

Obtaining the kits

The kits for all three systems are available directly from VAF Research Pty Ltd, at 60a Jacobsen Crescent, Holden Hill 5088; phone (08) 369 0669, or fax (08) 369 0634. Prices are as follows:

DC-2B: Full kit, including cabinets, \$359 per pair. Fully assembled, \$449 per pair.

DC-5: Full kit, including cabinets, \$465 per pair. Fully assembled, \$555 per pair.

DC-7: Full kit, including cabinets, \$699 per pair. Fully assembled, \$799 per pair.

These prices do not include packing, freight or transit insurance, but VAF Research has been able to organise special freight rates which allows the systems to be sent anywhere in Australia for \$19 in the case of the DC-2B or DC-5 systems, or \$25 for the larger DC-7 system. These figures include full insurance against damage in transit.

A matching spike kit is also available for the DC-7 system, to provide additional stability on carpeted floors. This is priced at \$20 including postage. ♦

Experimenting with Electronics

by PETER MURTAGH

Simple ultrasonic door minder

An ultrasonic beam provides the perfect minder for a doorway — you can't see it and you can't hear it (nor can your dog, hopefully!) However, when someone breaks the beam, our circuit switches a relay, which you can use to trigger any type of alarm.

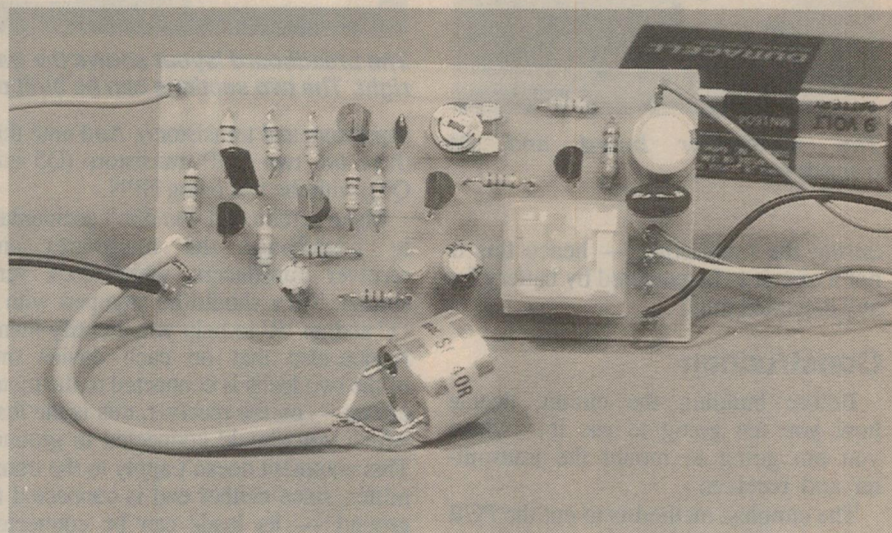
At the centre of this month's design are two devices: an ultrasonic transducer and an ultrasonic receiver. 'Ultrasonic' simply means high-frequency sound, above the range of human hearing.

The transducer contains a piezo-electric element which resonates at about 40kHz, so it can convert electronic signals into sound waves of the same frequency. The closer the frequency is to 40kHz, the more efficient is the conversion. When the sound waves are picked up by the ultrasonic receiver, the reverse process occurs.

Young, healthy ears can hear frequencies up to around 20kHz, so 40kHz is way above the hearing limit. And being sound waves, they are not obvious like a light beam. This makes an ultrasonic beam very useful for a hidden protector.

We have designed our 'minder' to monitor a doorway, so the signal only has to cover about 1m. We found, in fact, that this distance could be extended to around 3m. But to increase the distance beyond this, you would need a far more powerful amplifier. Because the transducers are not very efficient, we even need quite an elaborate amplifier to monitor the average door gap.

If you look at the schematic diagram,

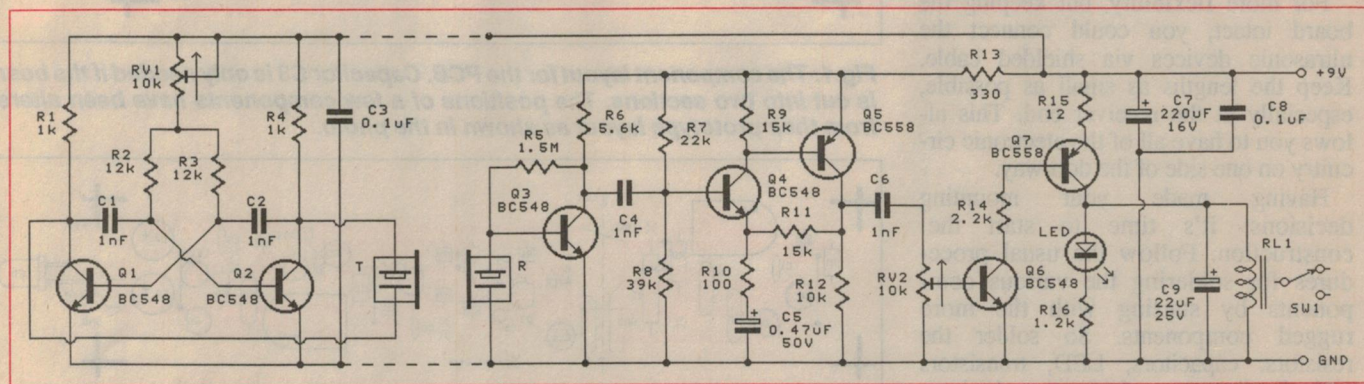


you can see that there are really two parts to our circuit. The first section, built around transistors Q1 and Q2, is an astable flipflop to produce the 40kHz signal which drives the ultrasonic transmitter. The rest of the circuit amplifies the tiny signal received by the ultrasonic receiver, and its output is used to turn on the relay.

The circuit is arranged so that the relay is turned on whenever the ultrasonic

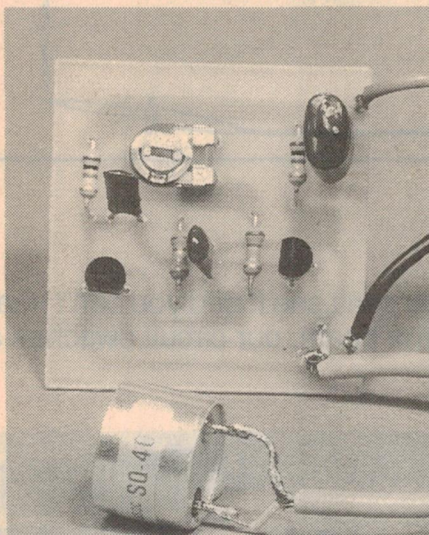
beam is being detected. That is, the relay is normally 'on'. Usually you would want an alarm to sound when the beam is broken; that is, the alarm is on when the relay is off. You can easily do this by switching the alarm with the 'common' and 'normally closed' contacts on the relay.

Please remember that this setup means that the flipflop, amplifier and relay are all drawing current (about 40mA total)



The variable frequency flipflop (based around transistors Q1 and Q2) drives the transmitter 'T', while the tiny signal picked up by the receiver 'R' needs to be amplified in three stages. The final stage (Q6 and Q7) is a class B amplifier which also rectifies the signal to drive the relay.

Experimenting



The transmitter board and its transducer.

during the monitoring — hence this is not a circuit to be powered by battery for any extended time!

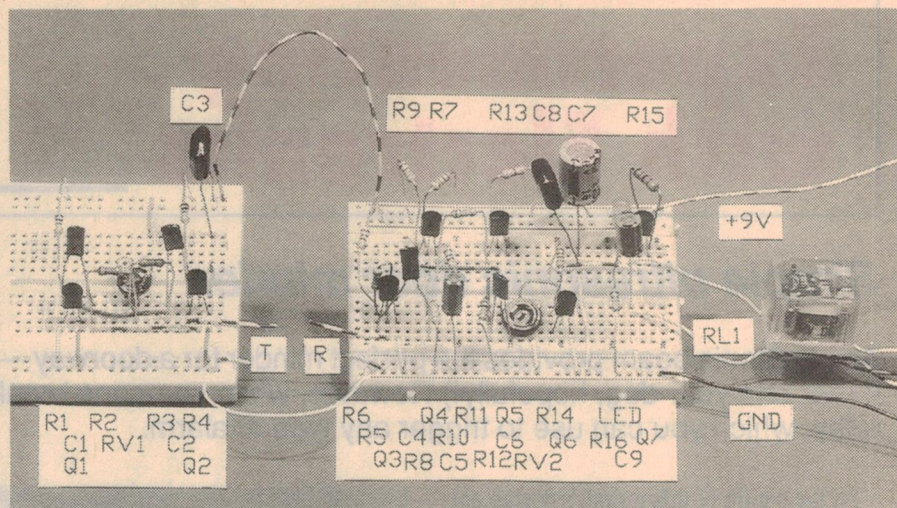
Construction

Before building the circuit, decide how you are going to use it—where you are going to mount the transmitter and receiver.

The simplest method is to cut the PCB into two sections (along the dotted line in Fig.1), and mount the two transducers directly onto the PCB sections. You shouldn't need to use shielded cable for the power leads running from the amplifier to the flipflop — capacitor C3 should eliminate any RF interference. While this approach is the easiest for construction, it complicates monitoring the doorway, since the boards, as well as the transducers, must be positioned with one on each side.

For more flexibility, but keeping the board intact, you could connect the ultrasonic devices via shielded cable. Keep the lengths as small as possible, especially at the receiver end. This allows you to have all of the electronic circuitry on one side of the doorway.

Having made your mounting decisions, it's time to start the construction. Follow the usual procedures for soldering the various components by starting with the more rugged components. So solder the resistors, capacitors, LED, transistors and finally the ultrasonic devices. Take care with the polarised components (refer to Fig.3 to identify the leads for the LED, electrolytic



The breadboard layout shows the transmitter on the left and the receiver on the right. The two sections can be built on the same board, if required.

capacitors and transistors). And note that there are two PNP transistors (Q5 and Q7), with the rest being NPN.

Make certain that you don't accidentally interchange the transmitter and receiver transducers, which look very similar. They should be stamped with a 'T' and an 'R' to help you identify them. Notice also that on each device one of the two leads is connected to the metal casing — on the receiver, this is the lead which you should connect to ground. This comment doesn't apply to the transmitter, since neither end is connected to ground — its leads can be connected either way.

We purchased our ultrasonic transducers for \$11.50 the pair, and paid \$2.50 for a suitable PCB-mount miniature SPDT relay.

Setup procedure

Because the LED starts to glow before the relay turns on, we can make use of this to set up the transmitter and receiver. The two transducers should be about 1m apart — roughly one door width.

Start with trim pots RV1 about centre position and RV2 turned fully clockwise. The LED should be glowing, and the relay clicked on. If not, line up the transducers so that they point more

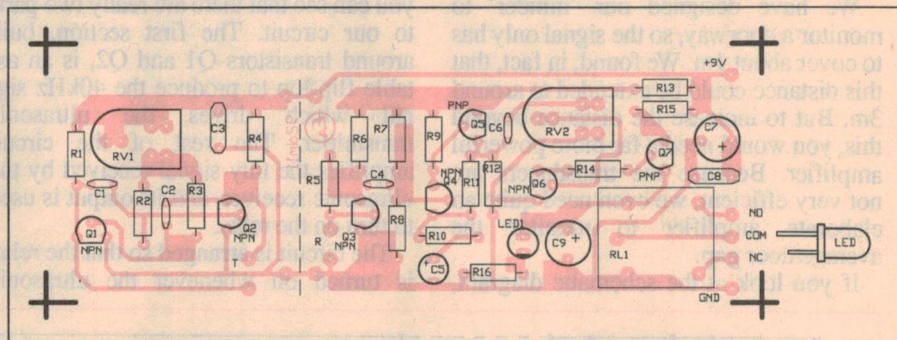


Fig.1: The component layout for the PCB. Capacitor C3 is only needed if the board is cut into two sections. The positions of a few components have been altered from their prototype layout as shown in the photo.

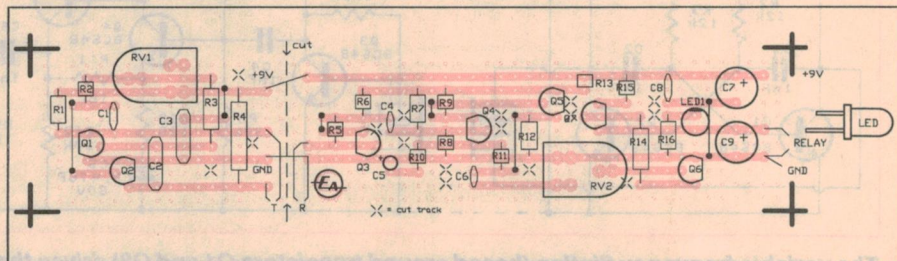


Fig.2: The stripboard layout. Extra 'cut tracks' are needed along the 'cut' line if all the circuitry is built on the same piece of board and not cut into two sections.

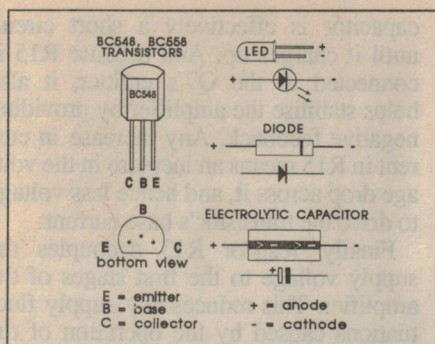


Fig. 3: The component leads identification diagram for the polarised components used in the circuit.

directly at each other — if necessary, move them closer together. Now rotate RV2 slowly anticlockwise until the relay clicks off, but the LED stays slightly on.

Next adjust RV1 to peak its output. Turning it in one direction should reduce the signal and extinguish the LED, while turning it in the opposite direction should increase the signal and click on the relay.

Each time the relay turns on, slightly wind back RV2 (anticlockwise) until the relay drops out. Continue the process until RV1 adjustments in *either* direction cause a reduction in signal. When this happens, the oscillator is producing the resonant frequency of the 'T' transducer. From now on, there should be no further need to alter the setting of RV1.

Next position the transducers where you wish to use them, and adjust the amplifier gain to suit this position. Do this by turning RV2 anticlockwise until the relay drops out, then turning it back slightly clockwise until it just clicks in again. At this point you should be able to walk through the beam, causing the relay to turn off, then back on.

If this operation does not happen reliably, you might have the units too far apart, or the transducers might not be pointing directly at each other.

You can check the latter by watching the LED as you re-position the transmitter — it should glow more, then less

brightly as you move the transducers in and out of alignment.

Changes

We have already discussed the major changes, which involve the placement of the transducers, relative to their respective circuitry.

The length of the wires providing +V and GND to the transmitter section should not present any problem, but too long a run for the wires connecting the transducers to the PCB sections could introduce interference — especially if you are not using shielded cable. And the further apart you move your transducers, the greater the potential problem.

When you are experimenting, remember that the receiver will respond to frequencies other than 40kHz (though not as efficiently). You might find that it responds to lower frequencies, e.g. whistling, or to higher ones, e.g. RF interference. Reducing the amplifier output (by turning RV2 anticlockwise) should reduce the first problem, and using shielded cable should prevent the second.

Unfortunately, the circuit cannot be easily modified to increase the amplifier gain, and so allow the units to be placed further apart.

How it works

The transmitter circuit (built around transistors Q1 and Q2) is an astable flipflop. The workings of such a circuit were described in detail in 'Experimenting' in the September 1991 issue of *EA*. However, briefly, what happens is this.

When power is first applied, base current (leakage) flows through the two transistors, Q1 and Q2, via RV1 and R3/R2, respectively. At the same time, the two capacitors C1 and C2 have started to charge up via R1 and R4, with the ends connected to these resistors becoming more positive. Suppose Q1 is the first transistor to turn on, and the voltage across C1 at this point is 5V.

PARTS LIST

Miscellaneous

PCB 122x44mm, coded 92dm11
9V battery
1 pair ultrasonic transducers (transmitter and receiver)
1 SPDT miniature PCB relay
1 LED, any colour
hookup wire, solder, etc.

Resistors

All 1/4W, 5%
2 1k R1, R4 brown-black-red
2 12k R2, R3 brown-red-orange
1 1.5M R5 brown-green-green
1 5.6k R6 green-blue-red
1 22k R7 red-red-orange
1 39k R8 orange-white-orange
2 15k R9, R11 brown-green-orange
1 100 R10 brown-black-brown
1 10k R12 brown-black-orange
1 330 R13 orange-orange-brown
1 2.2k R14 red-red-red
1 12 R15 brown-red-black
1 1.2k R16 brown-red-red
2 10k trimpots RV1, RV2 horiz. mount

Polyester capacitors

4 1nF C1, C2, C4, C6
2 0.1uF C3, C8

PC-mount electrolytics

1 0.47uF, 50V C5
1 220uF, 16V C7
1 22uF, 25V C9

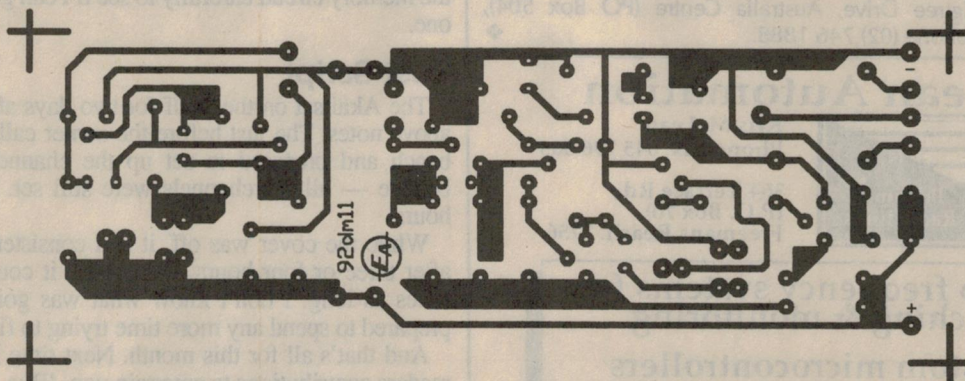
Semiconductors

5 BC548 NPN transistors Q1-Q4, Q6
2 BC558 PNP transistors Q5, Q7

At turn-on, the voltage at the collector of Q1 suddenly drops from about 5V to 1V, which means that the voltage at the right hand side of C2 — to maintain the 5V drop across C1 — must immediately drop to -4V. (This happens because capacitors cannot instantaneously change the voltage across their terminals.)

This negative voltage now turns transistor Q2 hard off. How long it holds it off depends on the size of C1 and RV1+R2 — because the current must flow through RV1+R1 to gradually raise the voltage applied to the base of transistor Q2.

This will eventually rise from -4V to about +5V, when Q2 will switch on. Turning Q2 on turns Q1 off, and the



The PCB pattern is shown actual size to allow experimenters, if they wish, to make their own boards.

Experimenting

process outlined above repeats for the opposite half of the circuit. And so on..

As the two transistors turn on and off in turn, this produces a continuous square wave. The values of R2/C1 and R3/C2 have been chosen to give a frequency of about 40kHz when trimpot RV1 is in its centre position. By adjusting RV1, the frequency can be altered, allowing the exact resonant frequency of the transducer to be reached.

Notice how the transmitter is connected to the two collectors. This means that it operates in a 'push-pull' manner, which produces a larger amplitude than if connected to just one of the collectors and ground. Instead of swinging from ground to 9V, the output at each terminal now swings 9V in *opposite* directions — effectively doubling the amplitude of the wave.

This ultrasonic signal is transmitted across the air gap and picked up by the receiver. Because this signal is very small, it requires a lot of amplifying before it can switch our relay.

Transistor Q3 provides a high-gain one-transistor pre-amplifier. Resistor R5 provides a system of feedback stabilisation to offset any current altera-

tion through R6 caused by differences in transistor characteristics and temperature changes.

The signal is further amplified by transistors Q4 and Q5, which form a complementary Darlington pair amplifier. This arrangement should look familiar — it was used in the 'Sound Switch' (March 19912) and the 'Loudness Display' (Sept. 1992)! It provides 100% DC feedback for stability, but low AC feedback, and hence good AC gain (theoretically 150, the ratio of R11:R10).

The final stage of amplification is done by transistors Q6 and Q7. These are arranged as a class-B amplifier, which responds only to the *positive* portion of the input. Using this type of amplifier means that we don't need a diode to rectify the signal, to provide a DC current to drive the relay.

Note that trimpot RV2 allows us to reduce the input signal of this final stage, and capacitor C9 smoothes the output. With C9 connected in parallel with the relay, we also don't need another diode to protect transistor during relay switch-off — the capacitor absorbs any surges.

And why have the 12 ohm resistor R15? Its role is to limit the surge of current which would flow across capacitor C9 when Q7 first turns on — the

capacitor is effectively a short circuit until it charges up. And because R15 is connected to the Q7's emitter, it also helps stabilise the amplifier by providing negative feedback. Any increase in current in R15 means an increase in the voltage drop across it, and hence less voltage to drive the transistor's base current.

Finally, resistor R13 decouples the supply voltage to the first stages of the amplifier. This reduces any supply fluctuations caused by the operation of the flipflop and the relay.

Capacitor C7 smoothes the overall voltage supply rail, while C3 and C8 help bypass possible RF interference. (C3 is not needed if the transmitter and receiver circuits are not separated.)

Transparencies

A high contrast, actual size transparency (negative) for the PCB used in this circuit is available for only \$2. This will allow you to etch your own printed circuit board. This special price applies for transparencies for all projects in this series only. Write to EA's reader services division.

Happy experimenting — and please send us your comments on the circuits we have published, as well as ideas for future projects. ♦

THE CHALLIS REPORT

Continued from page 24

After two months of listening to, as well as watching what the FV7 system can do, I am satisfied that provided the purchaser of this system also elects to install the full compliment of speakers, and then hires or purchases the appropriate software, he or she will derive just as much pleasure from the system as my family and I did.

The Kenwood RX-V7 receiver and LVD-V7 laserdisc/CD player units each measure 440mm wide by 400mm deep and 127mm high, with the RX-V7 weighing 12.5kg and the LVD-V7 a lighter 8.7kg. The RRP of the complete Forvism FV7 system with S-V7 speakers is approximately \$3999.

The FV7 system should be available from Kenwood dealers. Further information would also be available from Kenwood Electronics Australia, at 8 Figtree Drive, Australia Centre (PO Box 504), Homebush 2140; phone (02) 746 1888. ♦

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READER INFO NO. 20

THE SERVICEMAN

Continued from page 62

Only if the power failed for several hours, or the set was left switched off overnight, would the memory fail. He was more than happy with that and decided to take the set as it was.

So that got it out of my hair, but not out of my mind.

The memory should last as long as the battery keeps its voltage above say 3.5 volts. As far as I could tell, this would be several days for a fully charged battery. Yet in this case, the memory voltage failed even while the battery was still fully charged!

I don't know why, and now I don't have the machine to find out. But if I ever see another of these machines, I will investigate the memory circuit carefully to see if I can get a new slant on this one.

Post Script

The Akai sat on the shelf for two days after I had written the above notes. The just before the owner called in, I put it on the bench and prepared to set up the channels. And would you believe — all the channels were still set. After more than 48 hours!

While the cover was off, it had consistently lost its memory after three or four hours — yet now it could remember for 10 times as long. I don't know what was going on, but I wasn't prepared to spend any more time trying to find out...

And that's all for this month. Next time I'll have some more readers contributions to entertain you. 'Bye. ♦

Vintage Radio

by PETER LANKSHEAR



Renovating an RCA Model 20

In last month's column we looked at the model 20, RCA's first conventional TRF receiver, which was sold between November 1925 and the end of 1927. Although it was a relatively expensive model, more than 135,000 were produced and today it is well represented in collections. This month we have some restoration hints for the 20 and similar receivers.

The set I selected for the subject of this month's column is one of the 'single-colour black' models, and when found, it was in a fairly disreputable state. Unfortunately, the cabinet needed more than cosmetic treatment. The lid was distorted and the veneer had long open splits in several places.

Flat-topped radios have always, it seems, been irresistible to owners of pot plants, with the result that years of watering mishaps often do irreparable damage. I suspect that this set was a classic example. Even the layer of veneer on the inside of the lid was damaged, although

fortunately the labels and instruction card remained in good condition.

To compound the problem, the cabinet had been given the all-too-common treatment of a coating of varnish, probably in the vain hope that it would 'freshen up' the appearance. Of course it didn't, but instead now provided real difficulties in restoring the original finish. As the lid would have to be renewed anyway, it seemed that although removal of the original polish should always be a last resort, the most practical approach in this case would be to strip the finish from the panels and sides.

Dismantling

The first step was to withdraw the internals by undoing four screws on the underside of the cabinet, allowing the chassis frame complete with the control panels to be slid out. The removal of eight wood screws released the sloping panel covering the tuning and regeneration controls. The badge and escutcheons were removed and the tiny screws carefully stowed away. Replacements are hard to find!

Component removal from the small vertical panel was more involved. Undoing the machine screws through their dial plates freed the vernier tuning capacitors. Their knobs were removed and their connecting leads were unsoldered from the main tuning capacitors. Similarly, the volume and battery setting controls were released, but as their knobs are moulded onto the shafts, the wiper arms were disconnected. As there seemed to be no way to remove the jacks from the panel, these were disconnected from their leads and masked during spraying.

Next the lid and its length of piano hinge, lid stay and labels were removed. To assist in positioning them on a new lid, a template was made by cutting a piece of paper to size and rubbing the indentations with a pencil, in the same manner as a coin rubbing. A firm of fine furniture restorers successfully made a replacement lid.

Removal of the old finish was simply a matter of very careful scraping, mostly with a wide chisel held vertically. As the interior and back were in good condition, the finish was retained. Difficult spots, especially the routed patterns, were treated with paint stripper. Finally, after some minor damage was repaired the surfaces were prepared by sanding with 220 grit garnet paper, wrapped round a cork sanding block.

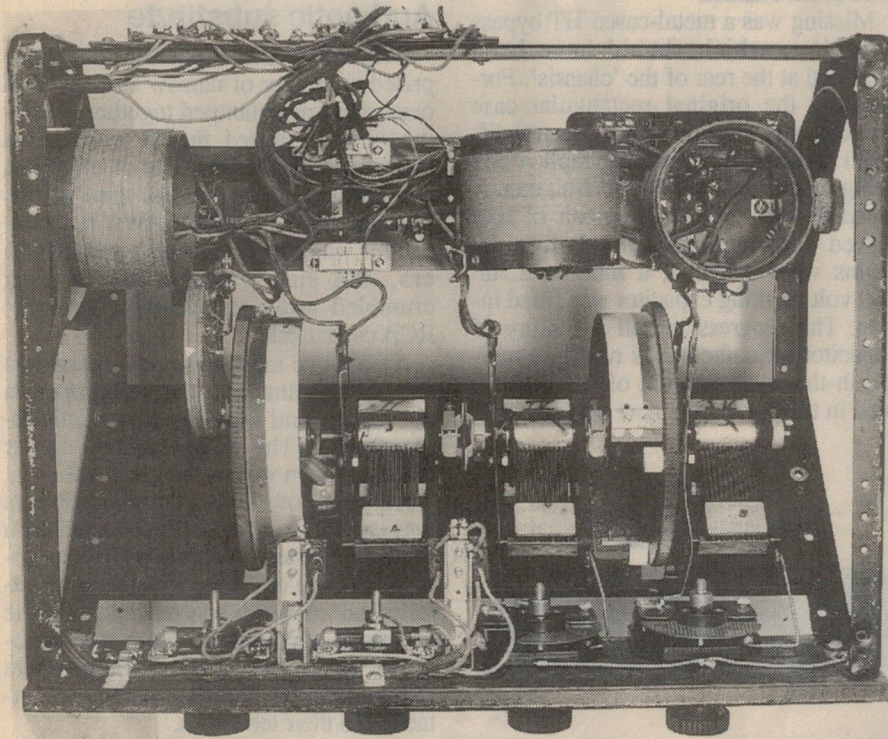


Fig.1: An underneath view of the RCA 20 chassis, before removal of the front panels. Between the detector coil at top left and the RF stage coil are the audio transformer mounts. The RF verniers and filament rheostats are at the bottom.

VINTAGE RADIO

Black wooden radio cabinets were finished in two ways. Although some were coated with black lacquer, many like the RCA 20 were stained and then sprayed with clear nitrocellulose lacquer.

A couple of coats of black spirit stain on the exterior provided sufficient colour. The inside of the new lid was given a coat of mahogany stain. Before spraying, the inside and back, which did not require refinishing, were protected with paper and masking tape. Then a couple of coats of clear lacquer were applied with a spray gun.

Brass polishing

The final job before reassembling the cabinet was polishing the brass escutcheons and dial plates. They too had been coated with varnish, and to avoid any possibility of scratching during its removal, they were given a coat of paint stripper and put in a plastic bag to prevent evaporation. Once the varnish had softened, the metalwork was given a scrubbing with soap and a nail brush before being polished with Brasso and a soft cloth.

The trick with polishing escutcheons is to not be too thorough. Completely burnished surfaces do not look right on old equipment, and indeed were often not so originally. A good rule is to concentrate on the high spots and larger flat surfaces, leaving recessed portions shaded.

After thoroughly removing residual polish, a light coat of clear lacquer was applied from an aerosol container.

Internal inspection

With the cabinet renovated, the condition of the internal components was thoroughly checked. In common with the great majority of receivers of this vintage, the audio transformers had long been replaced, in this case with miniature general purpose types that looked very clearly unoriginal.

Fortunately, one of the original transformers, although open circuited, was still with the set, and by advertising in a vintage radio magazine, a second RCA unit was located. Both were rewound to the original specifications. These are: primary 3000 turns 44 swg (0.08mm); secondary 12,000 turns 44 swg (0.08mm); core size 1/2" square; and window 1" x 5/8".

A problem frequently encountered in restoration is identification of alterations and missing components. Vintage radio societies are often good sources of data, especially of major brands, and members

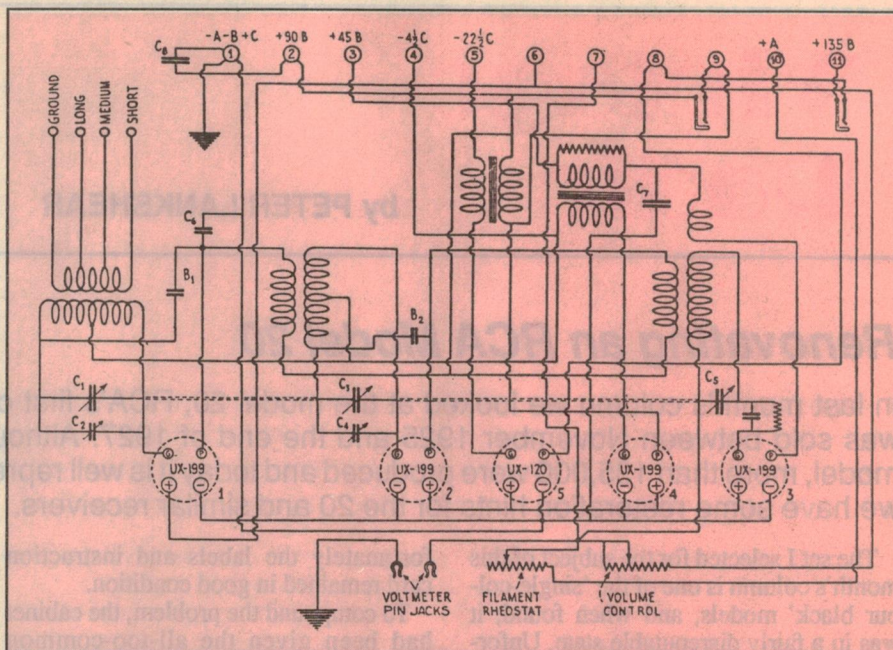


Fig.2: The 'continuity diagram' for the RCA 20 is based on the physical layout, and is useful for tracing the wiring.

will often help with advice and information. In this instance, I was fortunate in having a copy of the original service data and access to a couple of model 20's owned by local collectors.

Immediately apparent were some rust spots on the frame, which were treated with 'rust killer' solution and touched up with black enamel.

Missing was a metal-cased HT bypass capacitor, which should have been mounted at the rear of the 'chassis'. Fortunately the original rectangular case was ordinary tinplate, and it was not difficult to make a convincing replica box using metal from a flattened fruit can. A piece of fibre fitted with a pair of tags served as a terminal strip. Before the seams were soldered, a modern 2.2uF 200 volt working capacitor was fitted inside. The progress in half a century of capacitor manufacture is readily apparent in the small amount of space occupied in the box by the new capacitor. An

application of black enamel from an aerosol can finished the job.

The detector grid leak and capacitor had been replaced by modern components, and although they were out of sight under the valve shelf, I decided to replace them with some components that would be rather more appropriate.

Authentic substitute

Originally, the capacitor had comprised a number of narrow strips of thin brass and mica clamped together. Studying one, I realised that it was almost identical with the internals of the black composition-covered types used at one time by AWA. A 250pF AWA mica capacitor was squeezed with a pair of pliers, and sure enough the coating crumbled away to reveal a 'genuine' RCA capacitor!

An old one megohm, one watt carbon resistor was attached, the pair dipped in red enamel and I had a very realistic replacement. (The RMA resistor colour coding system was not in use in 1925).

Refitting of the audio transformers was easy. The cases were provided with lugs to bolt them together, and the original mounting brackets, which coincidentally had correctly spaced holes for the substitute transformers, were still in position. With the rewound transformers remounted, the loomed wiring was attached to their terminals.

A new battery cable was needed. An essential part of every battery powered receiver, these were made from coloured textile insulated wire with an overall

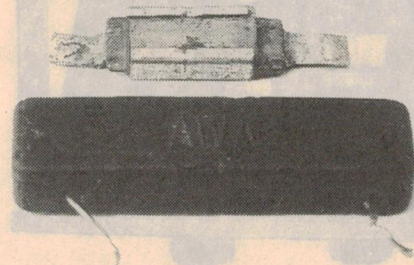


Fig.3: The internals of an old AWA mica capacitor are virtually identical with the early RCA construction.

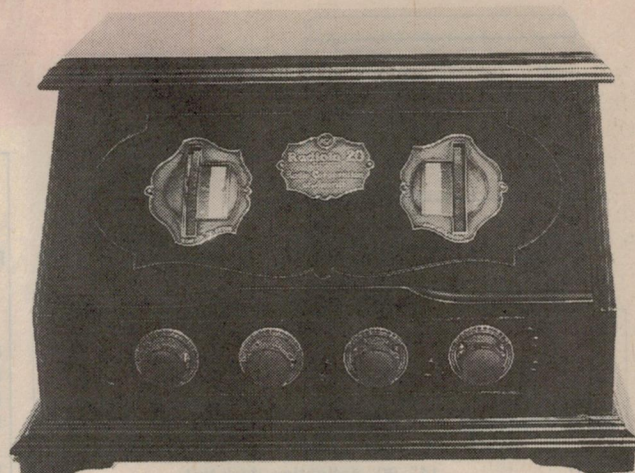
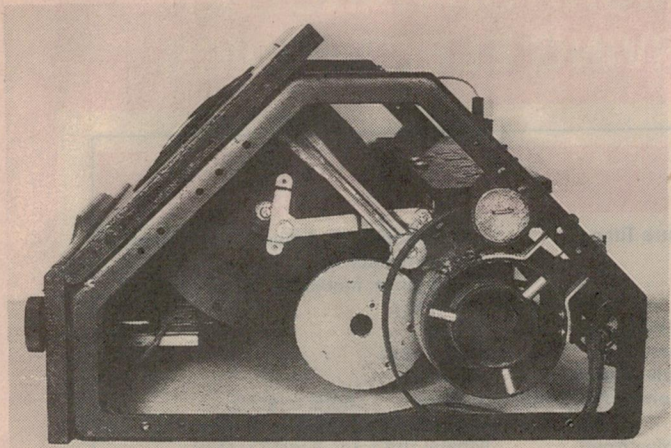


Fig.4 (left): Another view of the RCA 20's unusual construction. At the lower centre is the moveable regeneration coil, with its cranked arm connected to the 'amplification' thumbwheel. **Fig.5 (right):** Reassembled and with its new lid, the RCA 20 is operational and ready for display.

braided cotton covering. Fortunately, this type of cable is available from specialist suppliers and a two-yard length was obtained and connected. The cotton covering was cut back at each end and protected from fraying by whipping for an inch or so with waxed linen thread.

Substitute valves

Type 199 valves were first in production about 70 years ago and are now scarce, although good used replacements are available at about A\$25 each. Obviously, for initial testing at least, it would be prudent to use some valves that are a little less expensive.

UX-based general purpose triodes with similar filament current ratings will operate satisfactorily in a model 20. A practical choice is the more readily available 2.0 volt type 30, which although having a 40% greater amplification factor than the 199, has similar bias requirements. Similarly, the type 31 is a plug-in replacement for the 120. Of course, the filament voltage should be reduced from 3.3 to a maximum of 2.0.

When using type 30 valves, reducing the detector HT voltage may give a smoother regeneration control. Other suitable valves are the Philips A409 in place of the 199 and the B405 replacing the 120.

With a set of type 30 and 31 valves in the sockets of my receiver, a horn speaker was plugged into the speaker jack. As reversed connections to a horn speaker will reduce the strength of the magnets, a check was made that the positive speaker lead was connected to the jack sleeve. An outside aerial and a good earth were connected. Unlike later practice, the earth terminal in an RCA 20 is

not connected internally but must be connected separately.

The battery eliminator described in *EA* for March 1990, and also in my book *Discovering Vintage Radio* is ideal for this type of receiver. With the eliminator connected and the filament and bias voltages adjusted, the receiver was switched on. It worked, but the RF stages were unstable. It was clear that re-neutralisation would be necessary.

Neutralising

Triode tuned RF amplifiers are inherently unstable due to the internal grid-plate capacitance, and various methods were used to stabilise them. Series grid resistors were popular, but the best method was *neutralisation* as used in the RCA model 20. In effect a bridge circuit is arranged, so that the feedback via the grid-plate capacitance is balanced by an out-of-phase signal fed back to the grid via a small adjustable capacitor.

Although detuning and decreasing the filament voltage may help stabilise the RF amplifier stages in receivers of this type, correct neutralisation is essential for full performance. There are no short cuts, and hit and miss methods will not work. In any event, the basic method is simple enough. With a cold valve in the socket of the stage being balanced, the neutralising capacitor is adjusted to give minimum output.

The receiver was carefully tuned to a strong mid-band signal, with the regeneration control set well back. Then a dummy valve was prepared. The time-honoured instruction was to saw off a filament pin of a good valve! No one would do that today, but the same effect can be achieved by temporarily covering

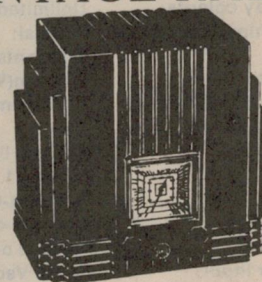
one filament pin with thin cellulose tape, so it is insulated.

With the dummy valve in the first RF socket, there was still some output from the speaker. The neutralising capacitors, similar to the more familiar mica trimmer, are mounted on the rear of the valve shelf. With a non-metallic screwdriver, the end capacitor was adjusted for minimum output. This adjustment is quite sharp and positive — a real 'null'.

The same procedure was then repeated with the second RF stage, using the other neutralising capacitor.

Now the receiver was stable and its performance much improved. All that remained was to fit it back into its case, producing the fine restored set shown in the photo of Fig.5. ♦

VINTAGE RADIO

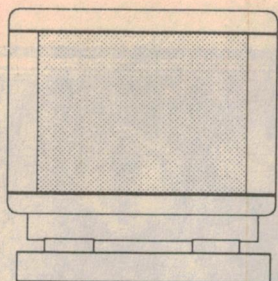


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POWER:	90-132 VAC OR 180-264 VAC, 50/60HZ (internal jumper selectable) degaussing : line operated automatic consumption : 90 Wmax.
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Video Bandwidth:	100MHz min at -3dB
Input Signal:	
Video:	Analog, 0.7 Vpp75 Ohm Analog, 1.0 Vpp75Ohm (Sync-on-Green)
Sync:	Separate or Composite Positive or Negative TTL
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Display Area:	260mm (W) x 195mm (H) typical
Video Bandwidth:	80 MHz min. at -3dB
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Video	Analog, 0.7 Vp-p 75 Ohm
Sync	Separate sync: TTL level. Horizontal sync: positive/negative. Vertical sync: positive/negative Composite sync: TTL positive/negative
Power Input:	180 - 260 VAC /50 Hz, 1.0 A rms Autoswitch
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Frequencies:	Vertical 48Hz to 90Hz
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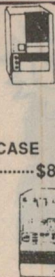
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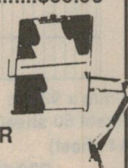
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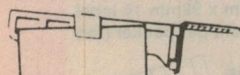
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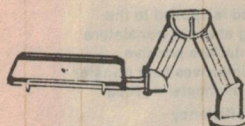


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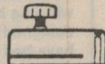
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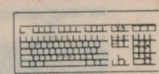


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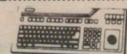
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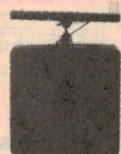
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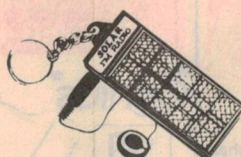


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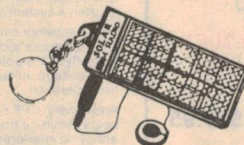
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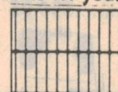
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1-9..... 10+...
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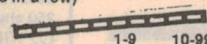
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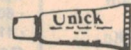
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1-9 10+
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- 5 PEEDY CHARGING :**
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Z19044

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Z19050.....\$12.95

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Adjustable arms allows easy positioning

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- Holds 5 disks
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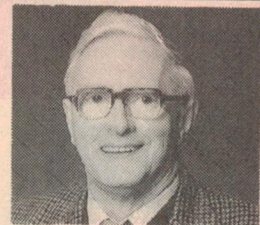
C12820.....	1-9	10+	100+
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- 3.5" Plastic disk holder
- Holds 10 Disks
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SHORTWAVE LISTENING

by Arthur Cushen, MBE



New Compere for Radio Nederland's 'Happy Station'

The world's longest running shortwave programme, the Radio Nederland 'Happy Station' has a new compere, following the retirement of Tom Meyer. Pete Myers is now taking over this popular Sunday evening session.

The first broadcast of the 'Happy Station' was made on November 19th, 1928 when Eddy Startz started this long running shortwave feature — by far the oldest programme in existence. The transmissions in 1928 were carried by PCJ, owned by the Philips Company at Eindhoven, and later it was broadcast over a radical new system — an aerial on a circular railway track, which could be rotated to beam programmes to any part of the world. Today, its modern counterpart is the log periodic antenna. Eddy Startz used the call sign 'PCJ' for Peace, Cheer and Joy.

It was on May 10th, 1940 that Germany declared war on Holland, and the fate of PCJ was soon determined. PCJ was able to continue for four days and nights, giving details of the German advance into Holland. Then came the decision to blow up PCJ rather than let it fall into the hands of the enemy.

After more than four years, Holland was recaptured by the allies, and the PCJ engineers went to work to put the transmitter back on the air.

Soon after it commenced broadcasting, it was taken over by the state-operated Radio Nederland and became an integral part of broadcasting from the Hilversum studios. Eddy Startz continued his broadcasts with many innovative ideas, including the arrival of mail in his mail coach. In June 1969, when I was privileged to be in the studio with him, his fantasy was that I had arrived on the mail coach to meet the 'Happy Station' listeners.

Eddy died in early 1970. His successor was Tom Meyer, who had been working at Radio Nederland since 1965.

Tom Meyer had a different slant on the 'Happy Station' and produced some new slogans, such as 'Smiles Across the Miles'. He really put variety into our Sunday evening listening. The 'Happy Station' has spread its influence worldwide, and regularly won international prizes and awards.

Tom Meyer announced recently that he is to retire from Radio Nederland — he feels he is young enough to take up his other interests, and after 22 years is looking forward to a break from radio.

Pete Myers is now behind the microphone at the 'Happy Station' each Sunday, and no doubt, he will also stamp his influence on the programme's content and presentation.

Born in India, Pete Myers lived there for his first nine years before going to England where he was educated. In 1957, he was in Ghana, and by accident got into radio at the age of 17.

In 1962 he returned to England and immediately joined the BBC World Service. There he did a daily programme for Africa, first called 'Good Morning Africa', then the 'Morning Show'. This programme ran for 11 years and was the most successful show on the African Service. Pete Myers is also a founder member of BBC Radio 1, the pop station which opened in 1968. During his three years, he interviewed a wide variety of people. Later, he was in the Lebanon running nightclubs, until the commencement

of the Civil War. Then in 1976 he joined the staff of Radio Nederland, and has been frequently heard in the English transmission. Now in his early 50's, he is looking forward to his latest challenge as compere of the 'Happy Station' programme.

The 'Happy Station' is broadcast every Sunday, and is transmitted to the Pacific at 0730 - 0830 UTC on 9630 and 11,895kHz, and at 0930 - 1030 on 9720 and 11,895kHz.

US stations have different role

International broadcasting in the United States is rapidly increasing, with newcomers to the shortwave bands almost every month. The latest two to be licensed are WEWN, to carry gospel programming, and WRMI to broadcast programmes of a commercial nature into the Caribbean.

For many years, Radio Miami International has been on the drawing boards, and finally, manager Jeff White has been able to purchase a 50kW transmitter, formerly operated by Radio Clarin in the Dominican Republic. The transmitter has been shipped to Miami and test transmissions are expected to be carried out shortly, with the call sign WRMI and the allocated frequency of 9950kHz. This frequency was requested from the Federal Communications Commission, (the US Government licensing authority) as it was the former channel used by Radio Clarin.

The latest gospel broadcaster to commence operation is WEWN from Birmingham, Alabama. This operation claims to be one of the world's largest privately operated services, and will employ four 500kW transmitters to carry programmes in some twenty languages. The transmitting site is on the border of Shelby and St Clair counties in Alabama. This is the latest venture of the External Word Television Network.

The FCC granted WEWN a construc-



Pete Myers the new compere of the Happy Station broadcast from Radio Nederland every Sunday.

tion permit in September 1991, and it is hoped that broadcasting will commence before the end of the year. The project is sited on 80 hectares, with several transmission towers 126m above the ground. The broadcasts will be 21 hours a day, in 20 - 25 languages, for reception around the world. One of the main areas to which the station will broadcast is Eastern Europe, a part of the world which only recently has been permitted to listen to religious broadcasts and take part in Christian services.

Most of the broadcasts will be scripture readings, either recorded in the Birmingham studios or at a larger facility near Rome, Italy. The tapes made in Birmingham will be in English, French, Spanish, Mandarin and Canadian-French, while the facility in Italy will concentrate on languages of Western and Eastern Europe. All tapes will be shipped to Birmingham for outward transmission on the 500kW transmitters.

The site is designed to cover two thirds of the world — the part outside the range of WEWN will be covered from transmitters in Asia. Negotiations are underway to hire time in this area. Mail to the station should be addressed to Mr Bob German, Chief Engineer, WEWN, 1500 High Road, Vandiver, Alabama 35176, USA.

WEWN commenced operations in October using the new 15m band frequency of 18,930kHz at 1300 - 1800, beamed to Europe using a 500kW transmitter.

Gospel service from Japan

A broadcasting organisation, with a gospel message in English originating from Japan has been widely heard using the facilities of Radio Moscow World Service. Two transmissions are broadcast every day, and the best reception has been from 2030 - 2100 on 15,385kHz, and 0430 - 0500 on 12,010kHz. The 15,385kHz frequency is used by Radio Moscow in English to 2030, followed by

the broadcast of Radio Aum Shinrikyo until 2058, when the Radio Moscow announcer gives frequency details. Then comes 'Midnight in Moscow', and at 2100 a news broadcast in English.

Reports and comments are requested to be sent to the following address: Radio Aum Shinrikyo, 381-1 Hitoana, Fujimomiya, Shizuoka, Japan 418-01.

The station verifies with a card giving frequency details, three books about the religious group, and a schedule which indicates that transmissions to Australia and New Zealand are at 0430 - 0500 and 2030 - 2100. At 0430 the channels include 9535, 11,710, 11915, 11970, 13,775 and 15,140kHz, while at 2030 - 2100 frequencies include 11,685, 11,985, 15,130, 15,170, 15,190, 15,560, 17,655 and 17,740kHz.

There is a tremendous number of frequencies being used, for instance, to South East Asia at 0430 they list 41 shortwave and two mediumwave channels.

VOA expansion

Following the destruction of the Voice of America's transmitter site at Monrovia, Liberia, the VOA put into operation a plan to cover part of Africa by installing four 100kW transmitters in Botswana. These are now all in operation. This meant, however, that West and North Africa were outside the coverage. To overcome this problem, the Voice of America has announced an agreement with the Government of the Principe of Sao Tome to establish a medium and shortwave complex on the islands — which are about 400km west of Gabon. Within two years, it is hoped to have four shortwave transmitters and one large mediumwave transmitter in operation.

According to Bill Whitacre, Chief of VOA's Frequency and Monitoring Division, operations on mediumwave will commence as quickly as possible with a 100kW transmitter. This will be replaced by a 600kW transmitter, which is expected to serve, during daylight hours, the main capital cities of West Africa which are all on the coast. According to Media Network, the whole operation should be broadcasting in 1995.

Sao Tome at present has its own domestic service, and this operates from the former Portugese colony on medium-wave and FM only. ♦

This item was contributed by Arthur Cushen, 212 Earn St. Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time.

AROUND THE WORLD

ARMENIA: Radio Yerevan is heard in English at 0245 - 0255 on 11,675kHz, also announcing 11,790 and 13,645kHz. Its address is given as 5 Mravian Street, Yerevan 375025, Republic of Armenia.

BELARUS: Radio Minsk verifies with a letter and, gives its schedule in Belorussian/German for Europe, 1830 - 1900, on 7210, 7330, 9600, 9645 and 11,960kHz; in Belorussian, 2130 - 2200, on 6160 and 11,960kHz; and to North America in Belorussian, 2330 - 0000, on 11,870, 13,645 and 15,580kHz.

CROATIA: Broadcasts from Zagreb of the Home Programme have been well received on 13,830kHz from as early as 0100 to past 0500. News is broadcast on the hour, and there is popular music for the balance of the service. At 0500 the news is preceded by the station's interval signal. Two other frequencies used by Radio Croatia are also observed: around 0400, 9830kHz provides a fair signal, and later at 0500, on 6210kHz.

CUBA: Radio Havana, Cuba broadcasts in English to North America on three frequencies: from 0100, they use 11,950kHz; from 0230, 13,710kHz and from 0400, 11,760kHz joins the network.

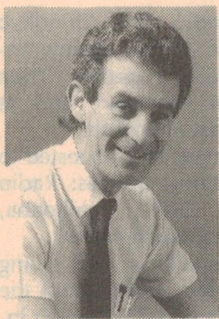
CZECHOSLOVAKIA: Radio Czechoslovakia International broadcasts in English to the Pacific at 0730 - 0800 on 17,725 and 21,705kHz; to North America at 0300 - 0330 and 0400 - 0430 on 7345, 9810, 11,990 and 13,715 and 15,355kHz. The station has announced that it has a large number of verification cards for Radio Prague and these will be issued to listeners — they will not be verifying as Radio Czechoslovakia International until new verification cards have been printed.

ECUADOR: HCJB is conducting tests on single sideband (SSB) on the frequency of 17,535kHz, 24 hours a day. The transmission in English is heard from 0030, and is a relay of the normal HCJB programme at that time to North America. Two years ago, HCJB purchased from Swiss Radio some 30kW transmitters which had been used for SSB in Switzerland. It has adapted them to test their potential from Quito. The tests still continue on 21,455kHz in SSB, with the power of 10kW. HCJB in its normal transmission to the Pacific operates at 0700 - 1100 on 945 and 11,925kHz.

ITALY: The Italian Radio Relay Service has a new schedule; 0730 - 1000, Monday-Friday, and 1900 - 2200, daily on 7125kHz. The IRRS's latest schedule indicates that it has irregular broadcasts at 1100 - 1700, using 7125kHz. There is also a test to North America, 0200 - 0300, also on 7125kHz.

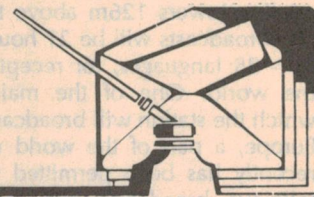
KAZAKHSTAN: Alma Ata is heard in English 1830 - 1900 on 3955kHz. Announcements indicate several other frequencies, 5958, 5072 and 4942kHz, as well as a mediumwave outlet. According to an announcement, the transmission is repeated at 2030, while at closing (1858), there is a request for reception reports to ul. Mira 175-A, Alma Ata 480013, Republic of Kazakhstan.

PHILIPPINES: Radio Philipinas, Manila broadcasts in English daily 0230 - 0330 on 21,580kHz, using a VOA transmitter. A service in the Filipino language is broadcast at 1700 - 1900 on 15,190, 17,840 and 21,455kHz.



Information centre

Conducted by Peter Phillips



Solar power, car radios and more

It's a very mixed bag this month, with items dealing with all kinds of topics — from solar power to car radios. There's problems that readers may be able to help with, some answers to other problems and a tantalising start to the proceedings!

Last month I introduced the column by discussing the possibility of projects associated with CD players. Since then, I've received another letter from the same correspondent who prompted my remarks.

It seems we're in for an exciting time, if our correspondent has anything to do with it. I'll say no more as nothing is definite yet, but as another writer puts it, 1993 could see EA 'coming up to speed' with digital audio...

Another area of technology that has cropped up occasionally in the magazine is solar power. This is an interesting area for most people, as the idea of 'free' electrical energy has many attractions. Unfortunately, the technology is still only at the battery charging stage, and has yet to become truly useful.

No doubt future generations will realise the technology required to efficiently convert the sun's energy so that electrical appliances, houses and cars can be powered directly by the sun.

We're all familiar with the solar-powered car and the various competitions that offer an incentive for designers to build the best solar car. On a smaller plane, this month's EA includes a similar competition, sponsored by Oatley Electronics. This competition is not seeking new ways of obtaining solar power (as this has foxed the best of researchers), but ways of using it.

Perhaps some of you have already developed better ways of capturing solar energy or ways of using it directly. If so, enter the competition and not only share your ideas but possibly win a prize.

It's appropriate therefore to start with a letter requesting information on solar power. Most readers are probably aware of its limitations — but not everyone, as the next letter illustrates...

Solar power

While I am not a true enthusiast of electronics, I enjoy browsing through your magazine. I have a question, which probably indicates my level of understanding of electronics.

I own a solar-powered radio which has its own internal rechargeable battery, and can also run on two AAA batteries. With the popularity of Walkmans, why hasn't somebody invented one that can run directly from a solar panel the size of your hand or the same area as a Walkman?

I also own a solar-powered Walkman sized cassette player, but again the solar cell only recharges a 3V battery, which can then power the player for about two hours.

It would surely make sense to have the solar panel large enough to run a cassette player and also have a bit more in reserve to charge the battery. This way, the battery can operate the player after dark. Is this possible? How large would a panel need to be? How could I power a portable cassette from a solar panel, perhaps at the beach, without having any batteries? Obviously I would need some sort of interface to keep the voltage constant to the player, regardless of the sunlight conditions.

I suppose the Japanese giants have looked at this scenario, and there must be good reasons why they haven't implemented it. Still, the saving on batteries, one of the most consumable of all items, would be immense. (C.S., Golden Square Vic).

Actually C.S., most of this is possible, in theory at least. For instance, in the August 1992 edition, Oatley Electronics advertised a solar panel measuring 150 x 150mm, at a cost of \$10. The panel can deliver up to 1W of power, which would

probably be enough to operate a portable radio. Two or three panels should be able to power a Walkman type cassette player.

However, to build such a panel into a portable radio or a cassette player is not really practical. Firstly, the power output of the panel is only available when it's exposed directly to the sun. Imagine walking and trying to keep the sun on the Walkman's solar panel!

The other problem is the size of the panel. Most portable radios and cassette players are smaller than the panels I've referred to, so I suppose an alternative is a panel you wear on your back. (Maybe there's an idea here for the competition!)

But using a solar panel to power a radio/cassette at the beach is certainly practical. If all goes according to plan, this edition should include a fluorescent light project that uses a solar panel. In this project, a shunt regulator is used to regulate the output of the solar panel so it won't overcharge the 12V battery that powers the light.

A regulator like this could be used to interface a solar panel directly to a radio/cassette. Another way is with a series regulator with an output voltage of 3V. However, it would make sense to include rechargeable batteries in the radio/cassette, both to keep the voltage constant and to give backup power when the sun goes behind a cloud.

Doorbell interface

These days, quite a few houses are fitted with an outside light operated by a movement detector. The light therefore operates when the sensor detects movement, giving the advantage of light to a welcome visitor and a possible scare to an intruder. But those inside the house may not be aware of the activity taking place outside.

Our next correspondent wants to make the doorbell ring when the lights come on:

I recently installed a Martec motion sensor security light at the front of my house. The unit comes with two floodlights and I also connected the existing porch light in as well.

What I would like to do also is interface the doorbell so it rings when the lights come on. The bell is a typical battery-powered pushbutton operated type. I can see how to simulate the button being pressed, but how to simulate it being pressed for about a second or so is the problem. Can you assist? (E.G., Rowville Vic).

There are quite a few ideas that come to mind, E.G. Because you've been able to add the porch light to the unit, it's obvious you have access to a 240V switched output from the security light.

The circuit shown in Fig.1 is one that I cobbled up and tested. It uses a 240:12V transformer, where the 240V side connects across one of the lamps switched by the unit.

When the sensor unit switches the lights on, the transformer delivers (in this circuit) 12V AC to the bridge rectifier. This is filtered by a 1000uF 25VW capacitor (value not critical), giving a DC output of about 15V. This voltage is then coupled via a 470uF capacitor in series with a 1k resistor to the base-emitter junction of a BD139 transistor.

The charge current taken by the capacitor flows through the base-emitter of the transistor, turning it on while the charge current flows.

This transistor connects across the pushbutton, with the collector to the positive potential of the pushbutton. I've chosen a BD139, as the transistor will need to pass the current taken by the door chimes, which could be 0.5A or more.

When the 470uF capacitor is charged sufficiently, the base current will drop and

the transistor will turn off. From my experiment, this will take a second or so, enough time to ring the doorbell.

The diode across the transistor prevents the back EMF of the inductive doorbell damaging the transistor. The 100k resistor across the 470uF capacitor discharges the capacitor so it's ready for the next operation.

You'll need to experiment with this, as I tested it with a 6V, 1A lamp, rather than a doorbell. For example, change the value of the 470uF capacitor to give the best time delay.

You can also use a different transformer voltage, perhaps 6.3V AC, but you'll definitely need to modify the value of the 470uF capacitor. The bridge rectifier could be replaced with a single diode (half-wave rectifier) as the current from the rectifier is only a few milliamps.

There are other ways, but I think this is the simplest. The only problem I see is false rings of the doorbell. I've noticed that lights operated with a movement sensor often come on when you drive past the house. Still, the circuit of Fig.1 is a simple interface that you can try.

Fan speed controller

The next correspondent wants to know if the Fan Speed Controller published in July 1991 could be used in a woodburning application. Yes, that's woodburning, or pyrography as the writer informs us...

Having an interest in pyrography (woodburning), some years ago I made myself a power supply for the pen by removing the secondary winding from a 240:48V, 2A transformer and substituting it with three turns of 8g copper wire. This gives about 2V at 30 amps.

To control the heat of the pen, I used a clumsy conglomeration of switches and light bulbs in series with the 240V primary. It was all very effective, but it looks a bit 'Heath Robinson' at best.

As the maximum power involved would

be about 60W, would the Fan Controller do the job in place of this light bulb concoction? Peter mentioned that he first used a light dimmer, which gave up on his fan. Why was this? I understand most light dimmers can control up to 500VA of lighting. All the best for your excellent magazine. (J.M., Aldinga Beach SA).

Thanks for your kind comments J.M. I can see no reason why the controller couldn't be used to control the output of a transformer, as a fan motor (for which the unit is designed) is a largely inductive load.

The prototype has now been continually operating a small exhaust fan for over 12 months, and the design is suitable for loads up to several hundred watts. I never discovered why the commercial light dimmer burnt out, although it might be due to the back-EMF of the inductive load destroying the triac.

Most light dimmers have little or no protection across the triac, as they are built into the smallest possible space. It was a 'cheap and nasty' dimmer, and possibly a more expensive unit would have survived.

Coils by computer

Since the advent of the Apple II, circuit design computer programs have been available. Perhaps the most common type is one that designs filters.

However, as the following letter points out, these don't help you design the required coil (assuming an LC filter). I haven't heard of a program that meets the need sought by the next correspondent, but perhaps other readers have:

I am looking for an IBM (or compatible) computer program that helps you design inductors. I believe there is such a program, where you enter the required inductance, the type (air or solid core) and it calculates the appropriate former to use, (height and diameter) and the number of turns required (or length of wire).

My main use is in passive speaker cross-over coils. I have already tried the ME Technologies P-Filter program, but it does not do what I require. (P.S. McDonald, PO Box 1241, Nambour, Qld 4560).

If anyone can assist Mr McDonald, either write to him directly or send the information to the magazine. In any case, I would like to know of such a program, as I can then mention it in these columns.

Dolby surround

I have had a number of letters asking for details of a suitable delay unit that could be used with the Dolby surround sound decoder described in January 1992. The next letter is typical:

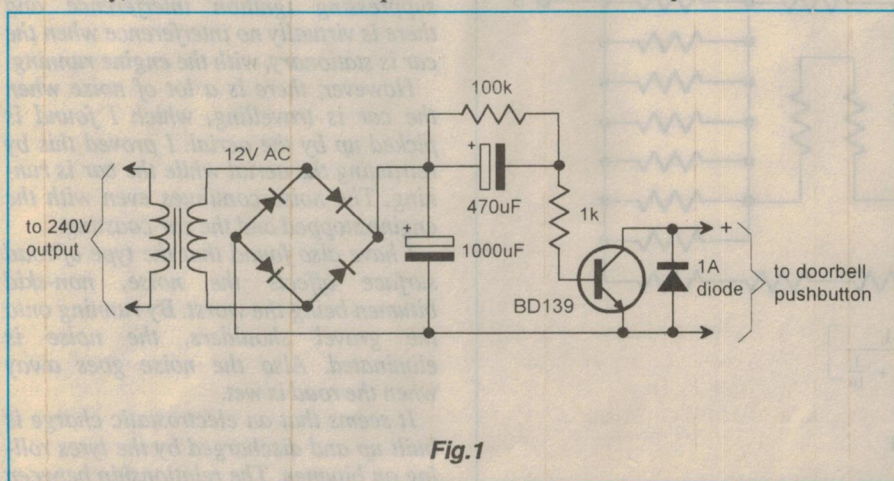


Fig.1

INFORMATION CENTRE

I am keen to build the Dolby surround decoder described in January, but I have a problem with the size of my room. To obtain suitable separation between the front and rear speakers, I would need to install a delay network. In the article, you talk of such a delay network, but there is no further mention of the unit.

Could you possibly advise me of how to build, or where to purchase such a unit. Or perhaps you could suggest how I can arrange the speakers in a small room for the best effect. (G.F., East Keilor Vic).

The designer of this project originally included a delay unit, but decided its benefits were not worth the extra cost. While he could not remember the complete details, the delay unit was constructed using a bucket brigade delay device, from applications information supplied by the manufacturer of the IC.

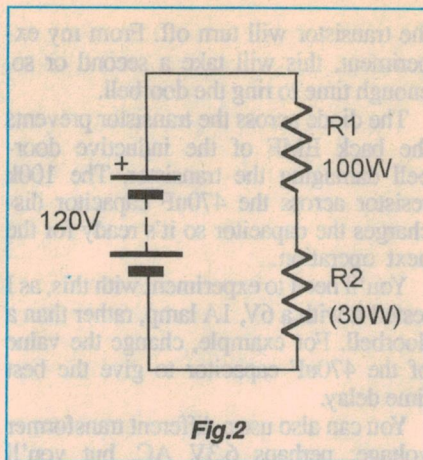
For example, Farnell sell a 3328-stage bucket brigade delay line, IC type 3011. The cost of the IC is around \$55, and extra components are required.

Farnell usually have applications data for most of the ICs they stock and can be contacted at 72 Ferndell Street, Chester Hill, NSW 2162 or phone (02) 645 8888.

Speaker placement is often difficult, specially in a small room. In its ultimate form, a Dolby surround system can re-create a sound moving all over the room, not just left and right.

A Dolby ProLogic system has four channels (right, left, centre and effects) while the system described in January has three. That is, there is no decoding for a centre speaker.

To get the best effect in a small room with the unit as described, the effect speaker(s) need to be placed a reasonable distance behind the listener. A possibility



could be installing them in an adjacent room. Placing them over the listener may not achieve the best effect, although with careful volume settings, a spatial effect should still be apparent.

However, a delay unit will help improve the separation, and in a small room, this may be the answer. The best listening point is somewhere between the front and rear speakers, which can be rather awkward in a small room. In any case, regardless of the size of the room, the Dolby unit will still enhance the sound effects from a Dolby encoded sound track.

Bass distortion

Here's another reason that might explain why some AM car radios have bass distortion. You might remember that this topic started in May '92 with some suggested reasons given in August:

I refer to the problem of AM bass distortion referred to Information Centre in the August edition. I suspect that this problem has nothing to do with detector non-linearity, but is in fact due to inadequate AGC filtering.

What happens is that the AGC sees the low frequency modulation as a signal variation and tries to correct for it by varying the gain of the IF amplifiers. This causes the bass component to cross-modulate the rest of the audio, giving the distortion mentioned.

The remedy is to use a larger filter capacitor in the AGC, if possible. My own car radio suffers from this problem, but it consists of several postage stamp-sized surface mount PC boards sandwiched together and I haven't been game to try and fix it!

By the way, on page 31 of the same issue, in the article on PLL demodulators, you refer to the 'standard' de-emphasis time constant of 75 microseconds. Please, this is not the USA! The time constant used here (and in most other civilised parts of the world) is 50 microseconds. (J.P., Tamworth NSW).

Thanks J.P., I must admit to being more comfortable with this explanation than that blaming the detector. AGC faults can give strange effects, and I agree that an inadequate time constant in the AGC line could give bass modulation.

Also thanks for pointing out the mistake in the article on PLL FM demodulators. As you point out, the standard in Australia is 50 microseconds, not 75 microseconds.

Car radio reception

On the topic of car radios and the problems associated with them, here's a letter about noisy reception that other readers may have experienced:

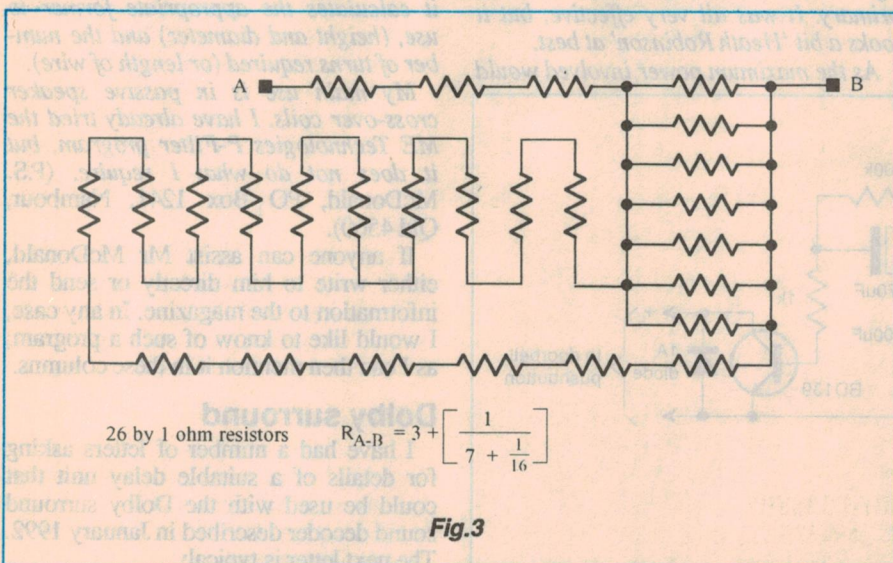
I have recently replaced my car with a new Honda Civic. This car is equipped with Michelin tyres. I live in an area where Sydney AM stations are rather weak.

The radio in the new car has a much improved sensitivity compared to that in my previous car (which was five years old). Honda has also done a top job in suppressing ignition interference and there is virtually no interference when the car is stationary, with the engine running.

However, there is a lot of noise when the car is travelling, which I found is picked up by the aerial. I proved this by retracting the aerial while the car is running. The noise continues even with the engine stopped and the car coasting.

I have also found that the type of road surface affects the noise, non-skid bitumen being the worst. By running onto the gravel shoulders, the noise is eliminated. Also the noise goes away when the road is wet.

It seems that an electrostatic charge is built up and discharged by the tyres rolling on bitumen. The relationship between



tyre and road is much the same as that with the venerable 'electrophorous', the antecedent of the Wimshurst machine and similar high-voltage electrostatic generators. Mother Nature uses the same effect in the accumulation of charges resulting in lightning. But why is this phenomenon only occurring now? I can offer some suggestions such as:

The increase in receiver sensitivity has exposed what has always been there, and I've just become aware of it. Or perhaps the tyre conductivity is different — maybe it's less conductive, or it has a greater propensity to generate a static charge. Possibly there is something about the vehicle itself that's contributing to the situation.

I'm inclined to think it may be the tyre rubber, as increased receiver sensitivity would not change the ratio between signal and electrostatic discharge noise. If so, is there a difference (accidental or deliberate) in brands of tyres?

One thinks of conductive rubber or graphite-bearing tyre dressings to reduce high voltage build-up. Do any of your readers have experience or ideas about this source of noise? (R.V., St. Georges Basin NSW).

An interesting situation, R.V. I can remember having a similar problem, and

the solution was to use graphite grease in the wheel bearings (as far as I recall). If any readers have further ideas, let me know, as this could be rather a common problem begging a simple answer.

What??

The question this month was sent to me by Douglas Bolton (Mt Waverley Vic) who found it in a text called *Introduction to Electric Circuits*, 4th edition by Herbert W Jackson (Prentice Hall). It's a simple enough question, but one that requires a bit of mathematical skill. The question is...

A 100-ohm resistor is connected in series with an unknown resistor (R2) across a 120V battery with zero internal resistance. If the unknown resistor dissipates 30W, what is its resistance? The circuit is shown in Fig.2.

Incidentally, there are two correct answers, which might give you a clue to the form of the final equation.

Answer to October's What??

The solution is shown in Fig.3. There are 26 resistors required, connected as shown. There could be other solutions, of course. ♦

NOTES AND ERRATA

SINE/SQUARE WAVE OSCILLATOR (March 1992):

Some kit versions of this project may produce a squarewave which has a small 'bump' in the centre of each flat section of the waveform — during both the high (+2V) and low (-2V) levels.

This occurs if the zener diodes (ZD3 and ZD4) controlling the supply rails of IC2 fall out of reverse breakdown, due to a higher than usual current drain through IC2.

The simplest solution is to lower the value of the associated dropping resistors R8 and R9, so as to increase the available current. Try reducing these from 470 ohms to 330 ohms.

CIRCUIT & DESIGN IDEAS

AUDIBLE TEMPERATURE AND OIL ALARM (June 1992):

The value of the resistor shown above the 100mA fuse should be 200 ohms, not 200M!

TASTIC TIMER (August 1992):

The author did not show on the schematic submitted for this timer the power supply for IC1 - IC3. A 9 - 12V supply should be suitable. ♦

COMING NEXT MONTH IN

Electronics Australia

COMPACT DISCO STROBE LIGHT

A new low cost design using a straight Xenon flash tube and a high efficiency reflector. Can operate at up to 10 flashes per second, either from the internal variable oscillator or from an external triggering source. Uses a transformer isolated power supply for maximum safety, with opto-isolated trigger input.

LOW COST MICROCONTROLLER DEVELOPMENT SYSTEM

An easy to build unit which is PC-driven, connecting to a standard parallel printer port. Can program the most popular models in Motorola's 68705 series of microcontrollers, and comes with software for cross assembly, simulation and programming of microcontrollers. Great for developing new micro-based designs!

MULTI-MEDIA AMPLIFIER

A compact, low cost 'active loudspeaker' design for use with personal cassette and CD players, and also to mate with your computer for 'multi media' applications. Features special equalisation for surprisingly good reproduction. Also makes a great utility amplifier/speaker for the test bench!

ALL THESE AND MORE IN NEXT MONTH'S ISSUE, DUE ON SALE NOVEMBER 25 — DON'T MISS IT!

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The Australian Electronics Development Centre (AEDC), now in its third year of operation, has successfully served over 300 companies throughout Australia with its product development and training programmes. In continuation of our commitment to providing the highest quality service throughout Australia, we are pleased to present the following courses;

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7M Tools	30 November & 1 December
Electronic Manufacturing Process Control	2, 3 December
Electronic Product Development	8, 9, 10 December

SYDNEY

Process Measurement for Managers, Designers and Administrators	7, 8 December
Access to International Markets	4, 5 November
Electronic Manufacturing Process Control	9, 10 December

ADELAIDE

Total Quality Management	19, 20, 21, 22 October
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Project Management	21, 22 October
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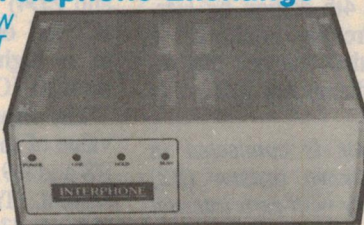


Mini Home PABX Telephone Exchange Kit

(SC Aug/Sept '92)

NEW KIT

This great unit allows you to place calls on hold, intercom other extensions, answer calls from any extension and transfer calls. It is expandable up to 10 extensions, and is compatible with all DTMF (touch tone) telephones. Operation is as simple as pressing '*' to place a call on hold, press the extension number (0-9) and the respective station rings. Once answered, you have a two way intercom, with which you can announce a call. To pick up the incoming call from hold press '#'. A neat feature is that all extensions will ring when an incoming call is placed on hold for 30 seconds so that it won't be forgotten. The Basic Kit is complete with power supply, case and facilities for 3 extensions. Extra extension boards allow expansion in multiples of 3. Simple operation, fantastic for home or small office. No more shouting from room to room. Not Austel Approved.



K 1430 Basic Kit **\$189.00** K 1435 Expansion Board **\$79.95**

Multi-Station Headset Intercom Kit

(SC June/July '92)

This multi-station headset intercom is designed to provide clear communication in high noise environments such as at race tracks and rock concerts. It is designed to operate with a headphone and mic combination. Each headset requires a station module. Stations are simply connected in a daisy-chain fashion. Up to 12 units (stations) can operate from the power supply. Features low noise circuitry and compares favourably to many commercial equivalents. Mics can be switched on continuously at one time for hands free operation of all stations. Also includes visual and audio call function. Ideally suited to our C 9055 headset/mic and the C 9070 noise attenuating Aviation Headset.

NEW KIT!
Compares to Commercial Units as Used in Industry Costing \$\$\$ More!



K 5250 Station Module **\$74.95**, K 5255 Power Supply **\$64.95**

Ni-Cad Battery Discharger Kit

Designed to rid your nicad batteries of the 'memory effect' and regain full recharge potential. It discharges your nicads correctly to enable a full recharge. Suits most battery packs. Great for mobile phones, battery drills, toys etc.



K 1640 **\$24.95**

Drill Speed Controller Kit

(S.C. Sept '92) Variable speed controller for 240V power tools including drills, power saws, engravers etc. suitable for brush-type tools up to 5A. Not suitable for globes or radiator heaters.

NEW KIT



K 6010 **\$39.95**

3 1/2 Digit LCD Panel Meter Kit

(S.C. Sept '92)

Ideal addition to power supplies, voltage meters, current meters etc. It can be calibrated to accurately read 2mV, 2V, 200V. Requires 9 volt power supply. Programmable decimal point.

NEW KIT!



K 2528 **\$34.95**

Sub-Woofer Adaptor Kit

(EA May '89) Get an amazing bass improvement from your stereo system. This fantastic adaptor simply 'samples' your stereo amp output and provides a single channel output to feed a separate sub-woofer amp. Requires 12V AC or M 9020 plugpack.

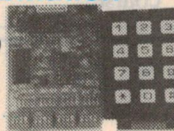
K 5560 **\$29.95**



Four Digit Combination Lock Kit

(SC Dec '90) K 1925 **\$44.50**

This 4 Digit Combination Lock is bound to prove useful in many applications. Such as accessing alarm systems, electronic doors, ignition killers or just about anything that comes to mind. Momentary or latched relay output.



Door Strike

Ideal for security access areas, this high quality lock will fit most door jams. Operates from 12V AC or DC. Ideally suited to K 1925 Combo Lock Kit.

S 4390 **\$39.95**



Apologies

In September & October ads we incorrectly advertised a K 3301 Power Supply Option for \$4.50. This should read \$29.50. ALTRONICS apologises for the inconvenience.

2 Way Active Crossover

(E.A. Jan '92)

This great new kit enables you to customize your sound system in your car or at home. The circuit simply connects between the audio source and the amplifiers. There are two outputs, one for bass and another provides signal for the upper range. Thus each amp is dedicated to a frequency range (i.e. one for bass, one for midrange and treble). Because no passive crossover is required in the speaker one per channel is required. Operates on + and -15V rails. The result is a much better sound with less distortion.



K 5570 **\$19.95**

Digital Altimeter for Gliders

This compact digital altimeter can display altitude up to 19,990 feet with 10 feet resolution. Accurate to better than 3.5 percent. A must for hang-gliders, ultralights etc. Operated on 9V battery.

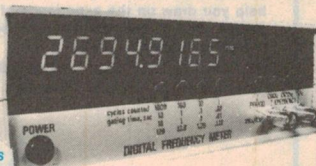


K 2580 **\$299.00**

1GHz Digital Frequency Meter Kit

(S.C. Nov '87 to Jan '88)

Features: Professional machined and screen printed red perspex front panel, easy to assemble and construct, no special tools required, bright Hewlett Packard 8 digit display, electronic switch latching, high performance IC's, high quality components
Specifications: Operational Modes: Period, freq to 10MHz, freq to 1GHz.
Freq. Range: 10Hz-1GHz (1.7GHz typical) in frequency mode; 10Hz-2.5MHz (5MHz type) in period mode.
Gating Times: 0.01, 0.1, 1 and 10 seconds (10MHz and 100MHz); 0.128, 1.28, 12.8 and 128 sec (1GHz range).



K 2515 **\$299.00**

Compares Favourably to Commercial Units Costing \$\$\$ More

High Power Amplifier Modules Kit

(SC Dec '87)

All components, including output transistors mount on a single PCB. Suitable for high quality guitar amp, public address or in a high fidelity stereo amplifier. Kit includes angled heatsink bracket, main heatsink and a in-built polyswitch for loudspeaker protection. Full specs available on request.

K 5140 100W Version **\$69.95** NOW ONLY **\$55.00**

K 5150 150W Version **\$99.95** NOW ONLY **\$85.00**

Megohm Meter Kit

(EA May '89)

Checks electrical wiring and appliances for insulation breakdown by passing high voltage (selectable 500 or 1000V) at low current through the test appliance. Includes calibrated megohms scale. Great for checking transformers, wiring etc. Requires 6 AA batteries (not included).

K 2555 **\$79.00**

Our Biggest Selling Kit!



Colour TV Pattern Generator Kit

(S.C. Nov '91)

This great kit makes servicing and aligning TV sets much simpler. Patterns include:
• Checkerboard • Crosshatch
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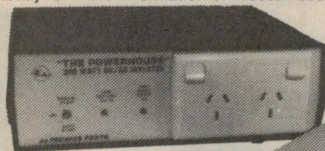
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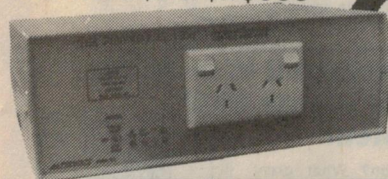
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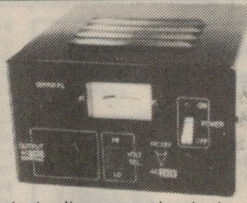


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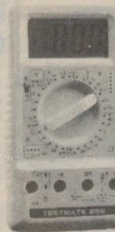
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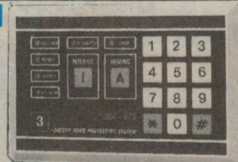
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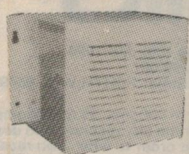
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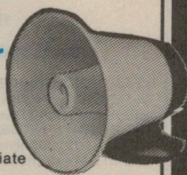


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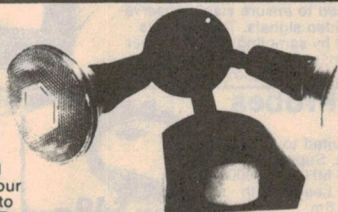
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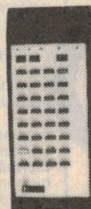
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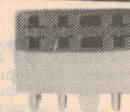
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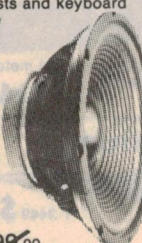
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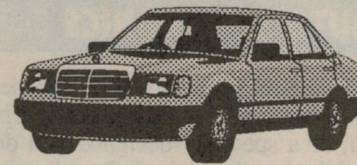
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AUTOMOTIVE ELECTRONICS



with MAJOR AL YOUNGER (USAR, Ret.)

Maintaining an 'electronic' car

The quality of maintenance of your computerised motor car directly affects its reliability, performance, driveability and workshop 'down time'. This month we look at what's expected by the manufacturer, in terms of basic electrical and electronics maintenance, and offer a guide for those who wish to do their own.

If your car's ECM (electronic control module) does not monitor a particular device or operation, that's because it assumes that the device is functioning correctly, or the operation is always going to be taking place. For example it assumes that the engine is capable of running properly — because if it isn't, the ECM can't control the system.

It also assumes the fuel flow is correct, even though a dirty fuel filter will restrict the flow. Since no production vehicle has a fuel flow sensor, it's clear that this is the assumption that ECM designers make.

On vehicles that don't monitor incoming air flow, the designer has obviously assumed that there will be no restrictions (or leaks). Yet if the air filter is dirty, it restricts incoming air flow...

On some cars, subsystems are not controlled by the ECM, because again it assumes they will be working.

All of this has a special significance, when you're approaching the maintenance

of a vehicle fitted with ECM, because if you don't perform proper maintenance and a fault develops, faultfinding is more complex. That's because when you're analysing fault symptoms you have to take into account the way the ECM works and what it will try to do, in response to a fault or problem caused by something it doesn't monitor or control.

The biggest factor is (you guessed it!) engine basics. The ECM again assumes the engine is running with all cylinders firing correctly, for example. It will see a misfire as a 'lean' condition, and try to compensate (in its closed-loop action) by making the mixture richer. So an over-rich mixture may simply be due to the ECM's response to a quite different problem, and reflect the limited information it has access to.

Here's another example. Some cars that incorporate an EGR (exhaust gas recirculation) system do not monitor the flow (opening). The ECM controls a so-

lenoid, which applies vacuum to open the EGR control valve. When the signal is sent, the ECM assumes the valve has opened and accordingly enriches the fuel mixture. It may also change the timing. But if the valve *doesn't* open, the engine will now be running too rich, and with inappropriate timing. So now the ECM will have two problems to overcome, if it can.

I guess the bottom line of all this is that the maintenance performed on non-electronic vehicles is even *more* important on electronic cars. But if you properly maintained your old vehicle, do the same on your new electronic car and you should have few problems.

Preventive maintenance

I was once asked "What is preventive maintenance?"

I responded with "What you do to prevent a failure, before it happens." It sounds redundant, but it's true!

Later in life, I redefined it as 'a state of mind'. This is justified because many people's 'state of mind' is *If it ain't broke, don't fix it*. In my experience, that attitude may well get you in trouble, terminated or physically injured.

I once had a butterfly fly into the phased-array antenna tuner of a 50kW transmitter — POW! Was it the butterfly's fault? My Colonel was still 'chewing me out' as I built a screen enclosure out of smaller mesh. Obviously, if some thought had been given to preventing such an incident before it had happened, that butterfly might have lived its full life. That's basically the idea of preventive maintenance — do the right things from the start, and disasters won't happen...

The internal components of an ECM can vary from 'off the shelf' items to those that are quite specialised. The

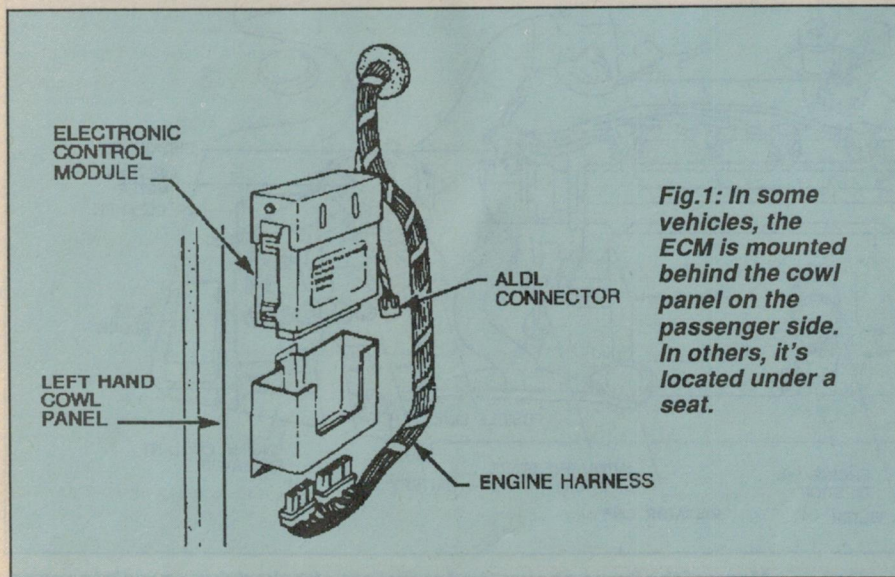


Fig.1: In some vehicles, the ECM is mounted behind the cowl panel on the passenger side. In others, it's located under a seat.

AUTO ELECTRONICS

CPU (central processor unit) can be either a 'full function' general-purpose chip, or a specially-designed and dedicated device. Any 'single board' processor is actually capable of doing the job, even a Z-80. This all depends on the particular system parameters — i.e., what the CPU is expected to control.

The most important factor, from the maintenance viewpoint, is the manufacturing techniques and testing.

Most ECM's are relatively 'bullet proof', at least in terms of their physical construction. The harsh environment of a car demands sturdy construction and severe environmental testing. Open the bonnet of a Mercedes, and you will see a large aluminium finned box. This is built like a battleship, to meet the harsh environment under the bonnet. Now open the boot of a Jaguar, and you'll see a neat looking anodised box. In both cases the ECM was manufactured to meet the environmental conditions.

What am I driving at here — what does this have to do with maintenance? Simply that from a sheer physical, hardware point of view, ECM's are generally very reliable.

Many people immediately condemn the ECM, when a modern vehicle has some kind of engine problem. Yet the facts are that over 75% of ECM's sent back as 'stuffed', turn out to be OK.

That's not to say that there aren't problems caused by ECM faults (especially software faults or shortcomings). But in the 'real world', most failures are actually caused by external factors. Things like no electrical power, poor or no earthing, exposure to water or coolant, and so on. Or the ECM may become damaged during the actual testing, or as a result of the biggest 'stuffer' of all: jump starting.

In your Owner's Manual, in the section about jump starting, just read the last line — which usually concludes '...serious damage may occur.'

Risk of damage

In this respect, of course, the ECM is no different from any other item of auto electronics, in being susceptible to reverse polarity damage. You may have from \$3000 to \$15,000 worth of electronics on your car — how much can you afford to lose?

I like to put it this way. If positive is joined to negative and vice-versa, your bank balance will probably be reduced by the cost of one ECM, which will exit in clouds of smoke. Every other electronic device may also be cooked, with your hifi now low-fry and your speakers no longer able to speak!

By the way, ECM's do not like water; if you like, 'Detroit' builds cars, not submarines. And your ECM is usually under the front seat, or in the kick panel (see Fig.1). The ECM's that are under

the bonnet cost more, because they have to be more rugged. Inside the car is a friendlier environment, except for water or — yes, even beer.

Where can the water come from? Well, apart from simple leaks of the car's outer skin, it can come from the coolant temperature sensor.

Fit a 'droop loop'

Coolant temperature sensors are made of an insulating material bonded to a metal outer shell. There is no 100% bonding of the two materials, and therefore leaks can occur. The leaking coolant travels down the sensor wires, and can end up corroding the ECM terminals. This occurs if the sensor is higher than the ECM. The remedy? — Place a water 'droop loop' in the wire.

Faulty air conditioners and broken heater hoses have also been known to allow water or coolant to enter the ECM. So check these too. Some ECM's on imported vehicles have a vacuum attachment, which can also allow water to run down into the electronics. If this happens, the remedy is again to add a long 'droop loop'.

In short, make a point of knowing where your ECM is, and take precautions to protect it against all liquids.

Other things that ECM's don't like is a bad earth. The ECM should have a good, reliable earth connection to chassis, close to the unit itself. Make sure it is clean and secure.

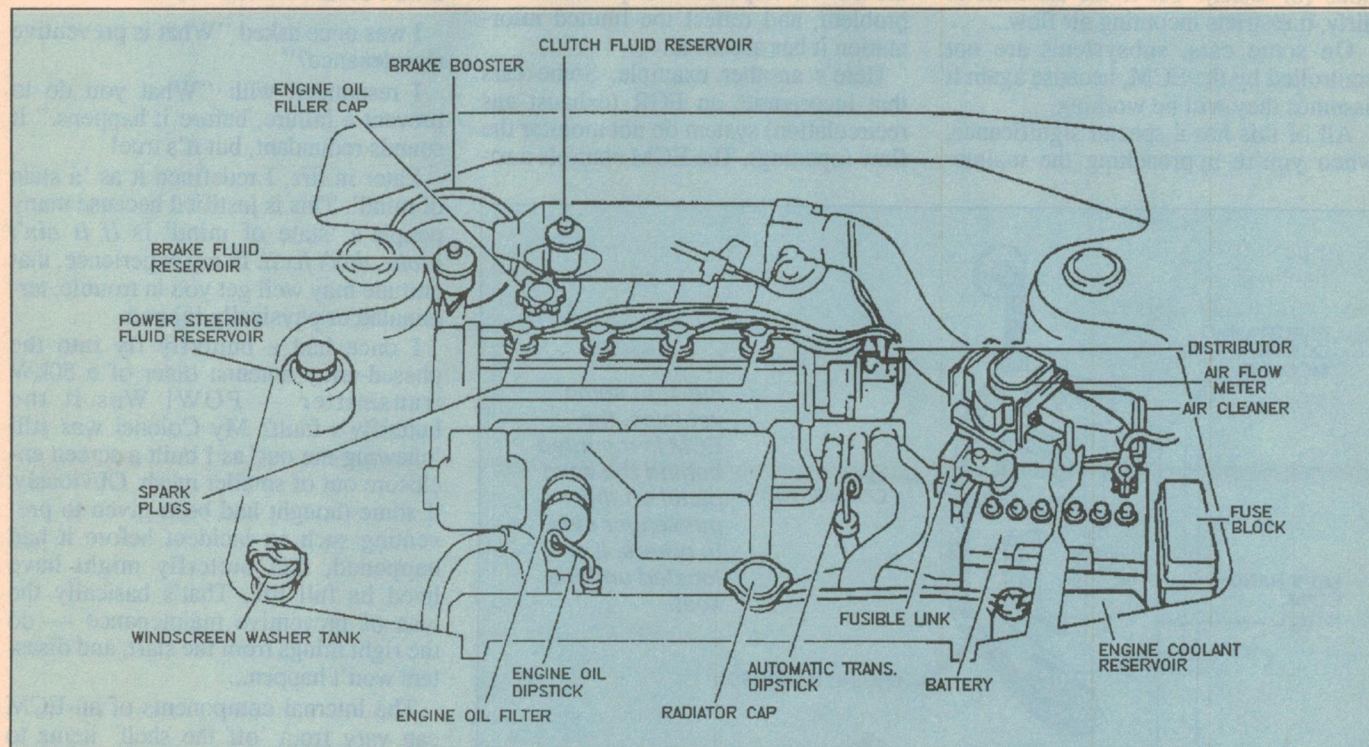


Fig.2: Inside the engine compartment of a modern car. Many of the items shown (and more) are checked during maintenance.

Some self-installed systems allow RF from radio transmitters to interfere with the ECM. The professional installers have generally solved this problem.

When you press the XMIT button, does it affect the ECM? My brother back in the States, a ham (K6PRU), had a kilowatt rig in the boot. When he hit the XMIT button, the car ran backwards — well, not quite, but it sure slowed down. His favourite trick was to pull up in my driveway, when I was recording audio or video, and start transmitting. Talk about RF saturation and slope detection — WOW! "CQ, CQ 40 metres, this is Kilowatt Six Peter Roger United", thundering in at 200 watts per channel through my audio system. You can imagine what this kind of RF can do to an ECM system in the same vehicle, unless the right precautions are taken.

Remove when welding

When a car is being repaired by a panelbeater, using plasma cutting or arc welding, the ECM should also be removed for its protection. I have seen ECM's with their memory (ROM or PROM) erased, when this was not done. Many ECM's do not have removable memory chips, and whole unit must be replaced.

The second problem, for ECM's and other electrical and electronic parts mounted under the bonnet, is excessive corrosion — caused mostly by battery fumes. Why some manufacturers place fuse or relay panels and major connectors near the battery, we'll never know. The acid fumes do a fine job of contaminating electrical components.

On one model, I automatically remove the 'Main Compartment Connector', clean it, coat with conducting grease, then seal it with RTV (Room Temperature Vulcaniser) — i.e., silicone cement.

The 'buff' who keeps a spotless engine compartment will eventually regret washing the engine. I don't mean the professionals who 'detail' engines and make them look new — they know what they're doing. Just remember that dirt will eventually 'wash' into a connector, and when dirt dries it becomes an insulator. That's when the trouble starts.

I dry wipe my engine compartment at least once a month. I keep a rag under the bonnet for that purpose.

Scheduled maintenance

Base the interval between your scheduled preventative maintenance sessions on the need of your vehicle in kilometres. If the air filter is dirty at 30km, enter in your vehicle log to check

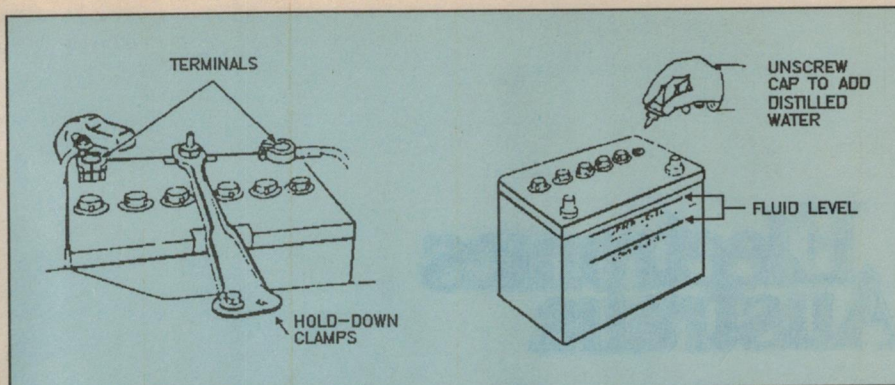


Fig.3: Batteries can self-destruct if the electrolyte level is not maintained.

at every 25km. Remove the fuel filter at 30km, and shake out any 'trash'; if you find any, again adjust the maintenance interval. In other words, let the need determine the schedule.

If you don't service your own vehicle, be guided by the mechanic at your garage. As soon as they say "The factory says you don't...", leave it.

When you do lift the bonnet for a preventative maintenance, do a visual inspection of the engine compartment (Fig.2). Look for loose wires, hoses, parts, and any signs of leaks or burns, etc. If something looks different or out of place, it most often is.

Check that the connections to the alternator are clean and that the belt is taut. If you see black residue with flakes of copper around air vents — see your mechanic.

I inspect the battery by removing the caps and checking the level once a month, adding distilled water as required (Fig. 3). When the terminals become corroded it needs a service. City driving with the air conditioning or any difficult starting problems, requires special attention. Batteries do self destruct, but usually because you let them. For example if you don't add water and the electrolyte level drops too low, the plates flake and fall to the bottom — and the battery shorts.

When I see terminal corrosion, I remove the battery and give it a washing with baking soda and lots of water. I then clean the compartment and all connectors and cables. Many alternators, batteries and starters have been sold because of poor cables and connectors.

Help — fix me!

The electronic car will tell you when service is required, but often too late. This is the scenario: you haven't had a service for about 50 to 80km. The engine takes a little longer to start. Now there is small hesitation to light throttle and a pause on a wide open throttle.

Soon it starts to backfire, and runs very erratic when cold.

Now, you decide, it needs a service. The air, oil and fuel filters are changed and new oil added. It runs better, but something is still wrong. Your mechanic tells you that all the backfiring has 'carboned' up your engine and it has to be cleaned out. Your injectors are also full of 'trash' and must be removed and cleaned (at \$40 each), and the backfiring threw your air flow meter (a mechanical device) out of calibration so it must be replaced. AFM's are very dear (they start at about \$600).

Backfiring in the intake (vacuum system), may destroy vacuum, MAP (manifold absolute pressure) sensors or any other diaphragm type device. Now you know where that saying came from, 'pay me now, or pay me more later'.

The bottom line

The key to successful scheduled preventative maintenance is lifting the bonnet, on a monthly basis. A visual inspection followed by routine cleaning are important factors in good maintenance.

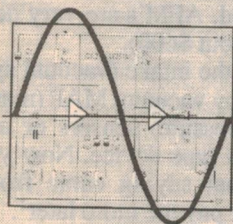
It takes some people a lifetime of turmoil to realise one fact of automotive life: that the car makers will not spend one cent on an item or device that is not required on a vehicle. If it's there, it has a purpose and it should function. If a mechanic tells you a device is not really required, smile — then go elsewhere.

To prevent untimely failure, both electrical and mechanical maintenance are important. For those who desire more detailed information and explanations, I have produced a small booklet which will give you a better understanding of your vehicle, and will aid you in conversing with your mechanic. It's titled *Maintaining the Electronic Motorcar*, and I'll post you a copy for \$20.00. Cheques only, please, made out to Al Younger, and send them to me care of *Electronics Australia*. ♦

BOOKSHOP

Preamplifier and Filter Circuits

R.A. PENFOLD



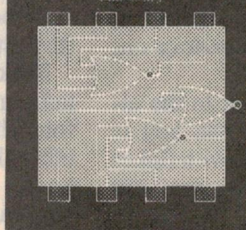
Preamplifier and Filter Circuits

This book provides circuits and background information for a range of preamplifiers, plus time controls, filters and mixers. The circuits described are simple and previous experience of electronic project construction is not needed.

CODE: BP 3090 PRICE: \$11.00

PRACTICAL DIGITAL ELECTRONICS Handbook

Mike Dwyer



Practical Digital Electronics Handbook

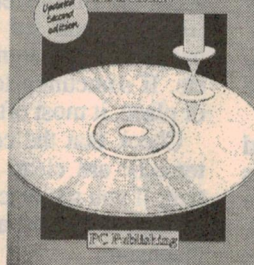
This book introduces digital circuits, logic gates, bistables and timers as well as microprocessors, memory and input/output devices. It will prove invaluable to anyone involved with the design, manufacture or servicing of digital circuitry.

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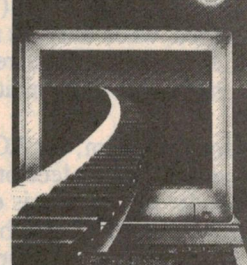
Introducing Digital Audio, CD, DAT and Sampling. - Second Edition:

This book bridges the gap for the technician and enthusiasts who have worked with audio circuits. It includes oversampling methods and bitstream techniques and technical terms.

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COMPUTERS and MUSIC

R.A. PENFOLD



Computers and Music - An Introduction:

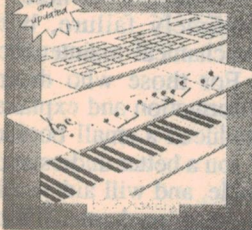
This book explains how to simply set up your own computer music studio. It covers the basics of computing, running applications programs, wiring up a MIDI system plus everything about hardware and the programs.

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Second edition

R.A. PENFOLD



Practical MIDI Handbook

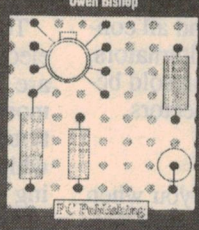
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Owen Bishop



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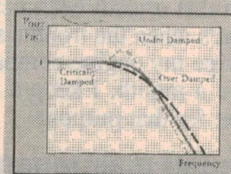
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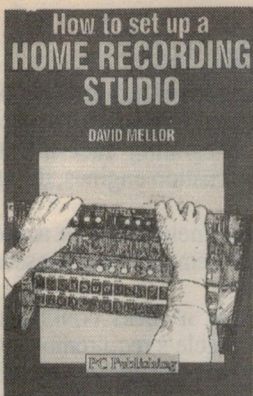
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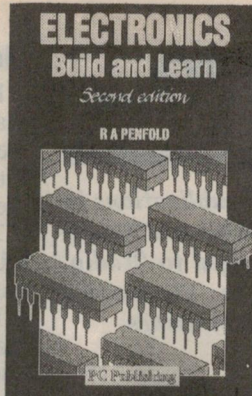
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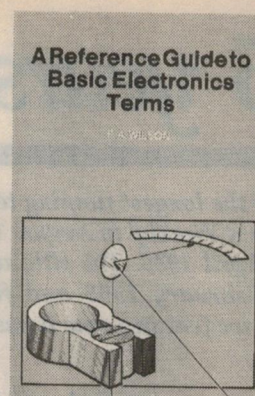
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How to set up a home Recording Studio
If you have a studio at home or are about to set one up, this book is for you! It describes the setting up of an 8 to 16 track studio with an outline of the musical and recording gear needed.
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Electronics - Build and Learn
This book is the perfect balance of theory & practice. It introduces common electronic components and how they are built into useful circuits. An essential for the beginner, providing practical tests and experiments.
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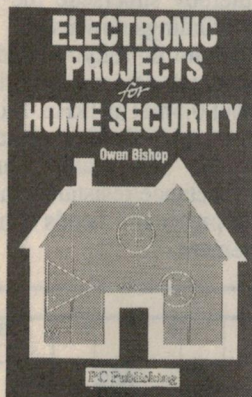
A Reference guide to Basic Electronic Terms
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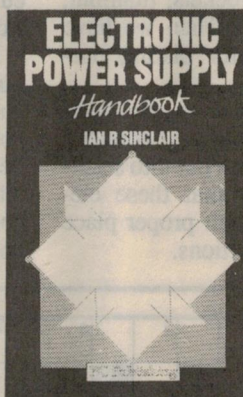
DATA BOOK

Mike Tooley BA

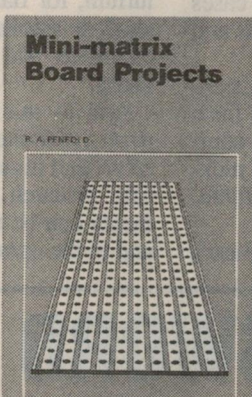
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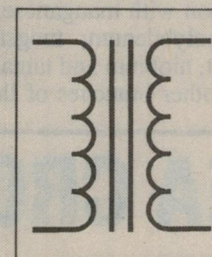
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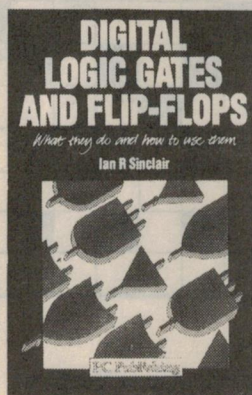
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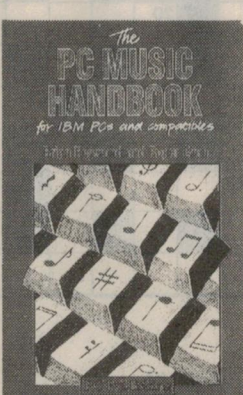
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50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

November 1942

Use of metals: Many years ago, the only metal known for war purposes was iron. But as new developments arose, such as the discovery of gunpowder, it became necessary to find other metals which could be pressed into use so as to increase the efficiency of the machines of war. Thus bronze and copper became the metals most favored for shell cases and the working mechanism of guns and cannon.

Today we find that almost all of the 90 known elements are used in some form or other. Armour steel is iron in combination with manganese, chrome, nickel, molybdenum, tungsten, vanadium, cobalt, niobium and tantalum.

In other branches of the war industry

we find uses for aluminium and magnesium, mercury, copper, zinc, tin, bismuth and lead.

Then there are the rare earths — caesium, used in sound detectors; zirconium, used as a substitute for mercury; radium and mesothorium, for illuminating the dials of instruments; selenium, barium, strontium and tellurium, for flares and rockets; titanium, used in smoke screens. Then we have cadmium and cobalt, for plating purposes.

Add to this list a host of other elements, and one can realise the enormous effort that must have been put into scientific research in order that these elements can be used in their proper place and in the correct proportions.

November 1967

Reducing air pollution: Air pollution may be reduced through the use of an electronic integrating fuel injector for internal combustion engines, designed in the USA.

The device meters fuel in accordance with the air temperature, pressure and engine heat.

In this way, it seeks continuously to match the vehicle's requirements of fuel, and thereby cuts emission of pollutants to a very great extent. Unburnt carbon, for instance is reduced to about 6% of the usual emission.

Solid state inductances for ICs: New microcircuit elements developed in Japan use Hall effect devices to synthesise inductances.

These may eventually become part of the internal circuitry of integrated circuits, and thereby supersede the bulky external coil windings now used.

A research team in Tokyo already has built experimental devices with inductances of about 0.5mH at 1kHz. It is now concentrating on finding optimum designs for the solid-state inductors, whose Q or reactance/resistance ratio — about 0.35 at present — needs considerable improvement.

EA CROSSWORD

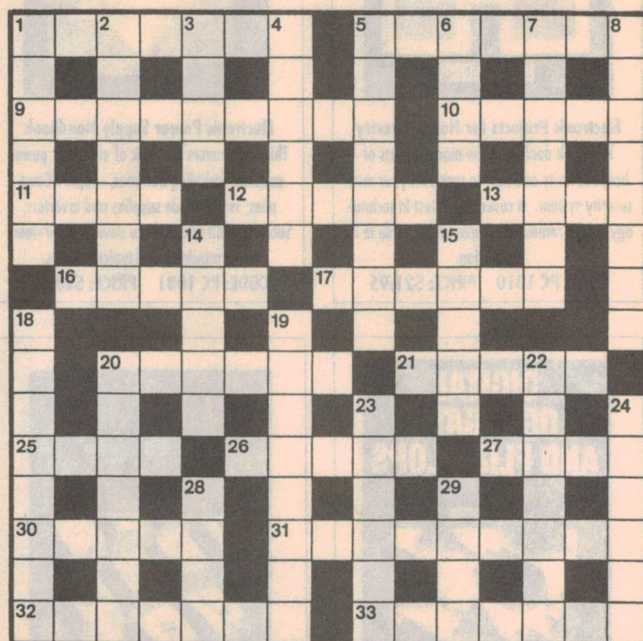
ACROSS

1. List within a list. (7)
5. Data in a signal. (7)
9. One found on the ground? (9)
10. Adjust a beam. (5)
11. Heat sinks do it. (4)
12. Lamps of a certain shape. (5)
13. Watch TV, etc. (4)
16. Well-known brand of copier. (5)
17. Destructive discharge. (6)
20. Viewing convenience on a screen. (6)
21. Communication channel for boats. (5)

25. Item that's electronically balanced. (4)
26. Melts, as does a fuse. (5)
27. Mathematically generated curves. (4)
30. Part of a lead-acid battery. (5)
31. Electrical quantity measured in volts. (9)
32. Enclose in protective clothing. (7)
33. Leading name in H-P. (7)

DOWN

1. Part of a loudspeaker, the — coil. (6)
2. Optically-read pattern. (3,4)
3. Reflected wave. (4)
4. Brand of electrical fittings. (6)
5. Large unit of information. (8)
6. Said of lower-frequency x-rays. (4)
7. Put information in a store. (7)
8. Said of a transverse layout. (4-4)
14. Made a winding. (5)
15. Said of a certain oscillator. (5)
18. Atomic variants. (8)
19. Rapid reduction (of magnetic



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TILT FAULT MOON
L M S O A B N I
ARTWORK SPACERS
N O U E M C I Y
DIPOLE MACHINES

- field.) (8)
20. Military manoeuvres often played out on computers. (3,4)
22. Add protective layer electrically. (7)
23. Circuit component. (6)

24. Colour in visible light spectrum. (6)
28. Rhythmic result of interference. (4)
29. Crystalline substance associated with drift! (4)

EA with ETI marketplace

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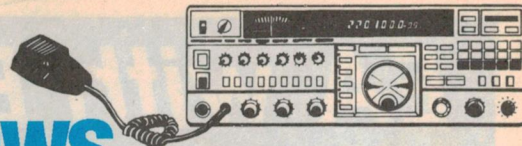
High quality sound reproduction isn't really all that hard to understand, despite the jargon that tends to surround it. Here's a new book which explains how the equipment works, what the jargon means, how to select the right equipment for your system and then how to set it up to get the best results.

The author is Neville Williams, formerly Editor-in-Chief of *Electronics Australia* and also one of the country's best-known and widely respected authorities on high fidelity. Mr Williams has tested and written about countless pieces of hi-fi equipment, over a 50-year period — there isn't much he doesn't understand about hi-fi!

In this book he explains all about high quality sound systems, starting with human hearing and moving all the way through to compact discs and the latest technology.

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Amateur Radio News



CW Operators QRP Club

Don Callow VK5AIL has sent details of the SA-based CW Operators QRP Club, and reminds us that he edits the Club's journal *Lo-Key*. The Club now has over 180 members, mostly in Australia but with about 20 'DX members' overseas.

Don writes that although the Club's name may sound as if it has a relatively narrow field of interest, in fact they welcome any radio amateur or shortwave listener with an interest in home brewing of equipment — especially simpler gear, and in the case of transmitters, of lower power output. ('QRP' is defined as 'less than 5W output power to the antenna'.) If you have an interest in CW mode, so much the better.

Membership of the Club is only \$10 per year, and included in the membership benefits is reception of the journal *Lo-Key* — published quarterly, and usually of about 25 A5 pages.

Don enclosed a sample copy of the journal with his letter, and it looks to be jam-packed with interesting technical 'meat' for the QRP enthusiast — including circuits and other constructional data for simple low power transmitters and receivers.

If you're interested in joining the CW Operators QRP Club, further information is available from Don Callow at 5 Joyce Street, Glengowrie 5044.

VLF experiments

The WIA's new Board apparently discussed the subject of allocating a VLF band for amateur use, at its last quarterly board meeting. In this context a note from a recent Sunday broadcast by NSW Division may be of interest:

Dale Woodside VK2TZ, who runs the St George Amateur Radio Society net on Thursday nights, advises that he has recently obtained permission to conduct low frequency band experiments, using the callsign AX2NAV.

Following in the footsteps of VK3ACA, who recently conducted CW tests on 196kHz as AX3T35, Dale tells us he has obtained permission to use AM and SSB modes, as well as CW, at power levels up to limits specified for normal amateur band operations.

Dale says he will be researching the design and implementation of 'practical, electrically small antennas' and will be using frequencies allocated also in New Zealand for experimental purposes: namely 175 and 185kHz, using the 9K00A3E mode.

He is obviously hopeful of some trans-Tasman DX contacts with other LF experimenters in New Zealand.

If you are interested in discussing LF band research with Dale, you can contact him on Thursday evenings at 8.30pm (EAST) on the St George net (Sydney) on 146.8MHz, or by packet where his address is VK2TZ @ VK2XSB.NSW.AUS.OC.

Automatic duplex operation?

The WIA's GM and Secretary Bill Roper VK3ARZ reports in the September issue of *Amateur Radio* that the Japan Amateur Radio League (JARL) has given brief details of a newly developed technology which achieves 'a single-frequency, two-way simultaneous communication radio equipment'.

This presumably means that there is no longer a need to switch from receive to transmit; i.e., the device functions in true duplex mode, like a telephone.

Apparently the equipment works by dividing the operator's voice signals into 200 millisecond segments and compressing each into half the time before transmission — leaving the other half of the time for receiving.

There's no indication when commercial gear based on the new technology is likely to appear on the market.

ARRL name unchanged

The ARRL letter of 27th July notes that 'The ARRL Board of Directors will not entertain changing the name of the organisation until next year at the earliest.'

Apparently further consideration was postponed 'so that the full rationale for the proposal can be shared with the membership'.

The letter also noted that a sum of US\$37,000 has been approved to conduct a survey to address membership recruitment issues. ♦

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**NEW FLEXIBLE, LOW COST SUITE OF PC-DRIVEN
DIAGNOSTIC TOOLS FROM BINARY ENGINEERING**

NEWS HIGHLIGHTS

CIS DIODES FOR ASIA'S ELECTRONICS

Tsvetron, the largest manufacturer of semiconductor diodes in the Commonwealth of Independent States (formerly the Soviet Union), is now using Hong Kong as a sales outlet to target Asia's burgeoning electronics manufacturing industry. Already the firm's 1N4148 silicon diodes have captured around 12% of Hong Kong's consumption of these very widely used devices, and it is confident of both increasing this share and also capturing a similar segment of the substantial markets in South Korea, Taiwan, Singapore and Malaysia.

Based in Brest, the Tsvetron factory was established in 1983 and employs 5000 workers. Its products were previously sold in Eastern Europe, and in its new push into Asia it faces heavy competition from both ITT and Telefunken in Germany, and National Semiconductor in the USA. However Tsvetron's diodes are nearly 20% cheaper, according to its HK distributor Mancon Technology. The only product that is price competitive apparently comes from China, but currently has a poor reputation for quality and reliability.

Total annual Hong Kong consumption of 1N4148 diodes is currently about US\$13 million, and the CIS diodes are expected to account for up to US\$3 million of this next year.

Tsvetron's Asian sales drive is being organised by trading company Nautilus, which has a background in ship broking with the former Soviet Union. Other products produced by the Tsvetron factory include zener diodes, electronic controllers, clocks and watches.

NPML ACHIEVES RECORD MAG FIELD

Australia's National Pulsed Magnet Laboratory (NPML), established earlier this year at the University of NSW by Experimental Physics Professor Bob Clark, has already set a world record for the most intense short-duration magnetic field yet generated without destroying the equipment. On July 28, a field intensity of 69.6 Tesla was achieved for eight milliseconds, without damage to either the field coil or current switching apparatus.

\$2M SATELLITE DISH FOR NEW NZ CARRIER

Clear Communications, the New Zealand alternative to NZ Telecom has commissioned a new \$2 million Satellite Earth Station at Auckland's Carlaw Park.

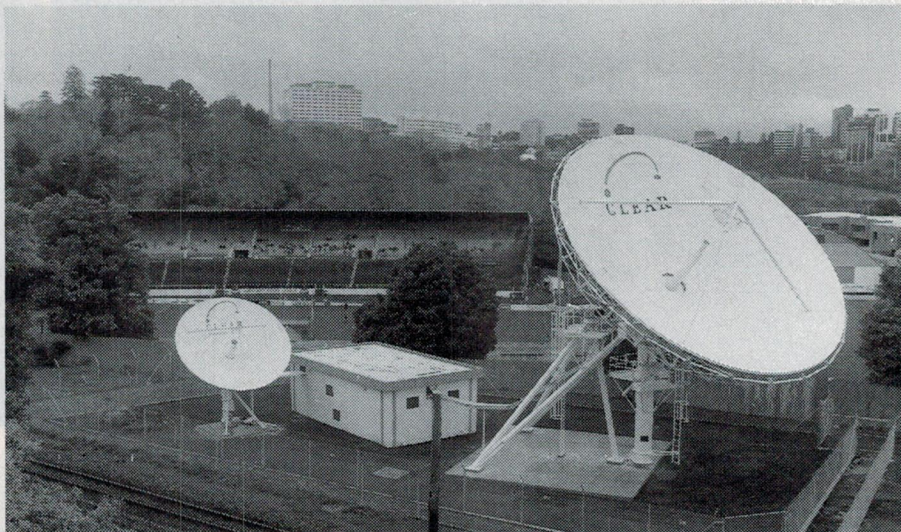
The Intelsat Satellite Earth Station, supplied by Scientific-Atlanta will allow Clear Communications to handle its own international telecommunications traffic, strengthening its independent access to international toll routes.

Having this system in place will mean no loss of revenue by having to switch to Telecom for traffic carriage from New Zealand. The 15-metre antenna of the

new satellite ground station will beam out toll traffic to Australia, the USA and other major correspondent countries in the Pacific, such as Hong Kong, Singapore, Japan and Canada.

Entry into Australia will be made through earth stations in Sydney and involves a link up with the Australian and Overseas Telecommunications Corporation (AOTC).

The new Scientific-Atlanta dish replaces a small station that offered about a quarter of its capacity. This dish bolsters existing capacity Clear has leased on the Tasman 2 optic fibre cable — which went live earlier this year — in conjunction with AOTC.



The previous record for field intensity had been established by a team at the Katholieke Universiteit Leuven in Belgium, led by Professor Fritz Herlach, which achieved a peak field of 69.5 Tesla. However the KU Leuven coil exploded in the process.

In a subsequent test, the NPML team achieved a peak field strength of 71 Tesla, but an arc-over occurred in the current switch — used to dump up to 800 kilojoules of energy, stored in a capacitor bank, into the coil. This caused damage, and has delayed plans to achieve a non-destructive pulse of over 70 Tesla.

Established at a cost of \$1.5 million, the NPML is funded jointly by UNSW and the Australian Research Council, and is planned to be a national focus for con-

densed matter physics research in Australia. Adjacent laboratories house ultra-low temperature, optical spectroscopy and high pressure equipment which will be used together with the intense magnetic fields for fundamental research into semiconductor systems including nanostructures, high temperature and high field superconductivity, and organic and magnetic materials.

Professor Clark is a member of an ASTEC committee due to report to the Federal Government this month on the need to establish a national facility for nanofabrication technology. This technology is expected to underpin the next generation of medical devices, biosensors, communications equipment and eventually consumer appliances.

AWA WINS \$20M CHINA CONTRACT

A contract worth nearly \$20 million to supply ground-based air navigation equipment to China has been won by AWA.

Mr John Dougall, managing director of AWA Limited, announced the award of the contract to the Aerospace Systems Division of AWA Defence Industries Pty Limited, explaining that "The contract covers highly specialised distance measuring equipment (DME) and Doppler very high frequency omni range (DVOR) beacons for the China Civil Aviation Authority's air traffic control program."

The contract was won against international competition, with strong support from Austrade.

SIEMENS WINS NEW CITY RAIL RADIO CONTRACT

Greater security and fewer delays should be the main benefits for train travellers when a new train radio system is installed on NSW passenger railways run by CityRail. The system will operate in an area bound by Newcastle in the north, Wollongong in the south and Lithgow in the west and includes the Sydney city underground.

The \$41 million contract was awarded by the State Rail Authority to Australian based Siemens Ltd, in conjunction with the UK based Siemens Plessey Controls Ltd (SPCL). SPCL is a major supplier of this technology to British Rail.

According to Siemens, it is the most sophisticated train radio communication system in Australia. Greatly improved communication between drivers and signal operators will significantly reduce the likelihood of delays and accidents which could result from confused messages and faulty connections.

The project is also expected to provide a boost to local industry. The majority of the total content will be Australian and the largest portion of this will be sourced in New South Wales.

1MW GENERATOR TUBE FROM SIEMENS

Siemens engineers have developed the latest in thermionic valves: a generator tube (RS 3700) with an extremely high output of over one megawatt, as required particularly in mechanical and plant engineering.

The high output means that in future only one tube will be needed for a 1MW generator instead of the two or more

NAVY TRAINING CENTRE TO CLOSE

Following rationalisation of Australia's defence facilities, the RAN's *HMAS Nirimba* trade training centre in Quakers Hill, NSW is to cease operation in December 1993.

Trade training at the centre began in 1952, with the supply of aircraft tradespeople to the RAN. *HMAS Nirimba* was commissioned in 1956, under the command of then Captain F.L. George RAN, and the centre has trained electrical fitters, fitters and turners, boilermaker welders, shipwrights and aircraft main-

tainers from then to the present day. Graduates have progressed to the highest levels of trade and engineering skills in private business, government service and large corporations. Several have also reached senior rank in the Navy.

Various events are being organised to mark the occasion of *HMAS Nirimba*'s closure, and a mailing list is being established to allow contact with all service and civilian personnel previously associated with the centre, who may wish to attend.

Those interested are invited to write to the Secretary, NCC, *HMAS Nirimba*, Quakers Hill NSW 2764.



needed to date — thus considerably simplifying the generator industry. The new tube operates in the frequency range up to 30MHz, and is capable of withstanding high load fluctuations due to its robust construction.

The generator tube is mainly used in inductive pipe welding and for hardening large work pieces which need to be heated quickly and evenly, such as gear wheels and vehicle parts.

MICROCONTROLLER DESIGN, SUPPLY SERVICE

Australian owned company McLean Automation has expanded its own OEM activities to include the development and supply of unbadged custom microcontroller units, for companies not wishing to carry out inhouse production. The versatility of software driven systems is such that the design cost is acceptable for even quite routine process control tasks.

Based around generic board level

product developed for short haul wireless telemetry applications, a salient feature of the system firmware is the provision of licence exempt radio based I/O in addition to the usual offering of wired ports common to such schemes.

A recent system consisted of an Australian Design Award winning automatic louvre control unit developed for a corporation specialising in the fitting out of shopping centres and architect designed complexes. The LCU automatically maintains chosen optimum light levels (and helps reduce air conditioning thermal loads) in a building by manipulating the motor drives on banks of externally mounted window louvres.

With a total once-off design cost of under \$8000, the finished microprocessor based product has completely displaced an imported hard wired logic based alternative.

Further information is available from McLean Automation, 364 Terrace Road, Freemans Reach 2756; phone (045) 796 365.

NEWS HIGHLIGHTS

JAPANESE FIRMS TO MAKE LITHIUM ION CELLS

Toshiba Corporation and Asahi Chemical Industry Co., Ltd., are to establish a joint venture company, A&T Battery Corporation, to develop, manufacture and market lithium ion rechargeable batteries. These next generation environmentally friendly batteries offer small size and light weight.

The joint venture company will initially build production lines at Toshiba's Horikawa-cho Works, in Kawasaki, south of Tokyo. Mass production will start in October 1993, at a monthly production volume of 500,000 batteries. Sample shipment and marketing was to begin in October this year, using the existing small capacity production line in the Horikawa-cho Works.

Mr Hiroshi Ohhama, Vice President of Asahi Chemical Industry noted, "Lithium ion rechargeable batteries provide twice the power capacity and three times the service voltage of nickel cadmium batteries, and generally superior performance characteristics. They will meet the urgent, fast-growing need for a lighter smaller power source in portable telephones, 'notebook' computers, camcorders and other electronic equipment."

Lithium ion rechargeable batteries use lithium compounds for the anode and a special carbon for the cathode. Movements of lithium ions in electrolytic solutions cause the batteries' charge and discharge reactions. As they do not use harmful heavy metals such as mercury and cadmium, they are environmentally friendly. The market for lithium ion rechargeable batteries is expected to expand rapidly as next generation batteries follow on from nickel metal hydride batteries.

10,000TH OPTUS MOBILE CUSTOMER

Optus Communications, Australia's new telecommunications carrier, has signed up the 10,000th customer for its mobile telephone service.

The 10,000th customer, computer and communications consultant Mr Geoffrey King, bought his mobile telephone at the Pitt Street retail store. To celebrate the milestone Optus refunded Mr King the full cost of his Motorola mobile phone, and presented him with a number of equipment add-ons, that will make his telephone an even more productive business tool.

BIG CHINA F-0 CONTRACT TO PIRELLI

Pirelli Cables Australia has won what is understood to be the largest contract for optical cable supply ever placed by China. Pirelli, the largest supplier of optical fibre cables in Australia, is manufacturing \$10 million worth of cable for delivery to the Hunan Post & Telecommunication Bureau between now and the middle of next year. The armoured loose tube optical fibre cable will be used for aerial installation, allowing the bureau to upgrade 2300km of its network.

Pirelli's Managing Director, Mr Colin Bale, says the contract was won against tough competition from other Australian and international companies.

The Hunan contract is the third Pirelli has won from Chinese customers in recent months. Henan and Liaoning Provinces this year each purchased 300km of optical fibre cable for their telecommunication networks. The cable is being manufactured at Pirelli's Dee Why, NSW, plant.

HITACHI, GRIFFITH UNI IN JOINT VENTURE

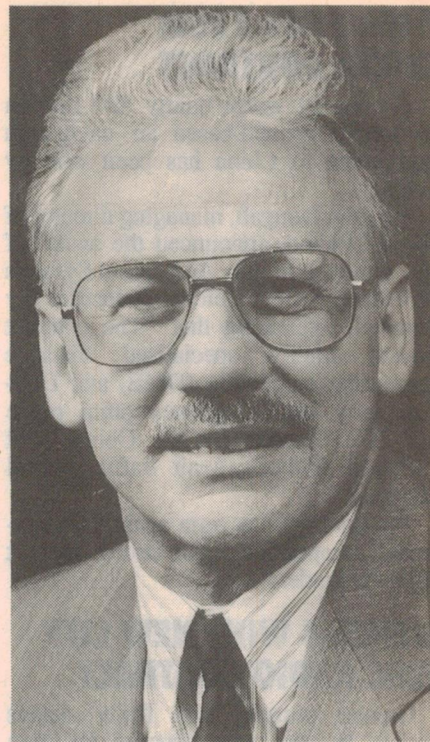
Queensland Premier Mr Wayne Goss and Mr Gary Moore, president and chief executive officer of Hitachi Data Systems, have signed an agreement to establish Microelectronic Technologies Pty Ltd (MET), a joint venture between Hitachi Data Systems and Griffith University, Brisbane.

MET has been established as a centre for design excellence in microelectronic technologies and will work to develop products in the areas of integrated circuits, microcontrollers, and software and systems development. The University expects its investment in MET to enhance its educational programme and create closer ties between industry and the students and staff at Griffith and other Queensland universities.

Commenting on the agreement Gary Moore said, "Our joint venture with Griffith University is part of our commitment to promote local research and development, and export opportunities."

"Hitachi Data Systems are committed to investing more than three quarters of a million dollars in the venture, and provide management and administrative support. This investment is complemented by Griffith University's contribution of microelectronic expertise and operational facilities," he said.

The organisation will operate as a strictly commercial venture at the Mount



Gravatt Research Park and to date has been encouraged by the Federal Government's Offset Programme and the Queensland government.

PAY TV MAY CREATE 3000+ JOBS

Pay Television will have a significant impact on Australia's economic recovery, with an estimated 3000 to 3500 jobs being created this year and throughout next year, according to the managing director of Scientific-Atlanta Australia, Mr Steven Dean.

Mr Dean, whose company has already supplied Optus with some basic infrastructure needed for the transmission of TV, said employment opportunities running into several hundred jobs would be created soon after the Pay TV licenced operation was appointed.

"Equipment manufacture will not represent a major direct employment factor, but marketing, sales and other support activities will be a significant employer, estimated initially at well over 300 people."

However, Mr Dean said that customer service for Pay TV would be one of the largest employers, with his estimate being at least 800 jobs. Mr Dean said the installation of equipment would require the services of several hundred people.

"In the case of satellite direct-to-home reception, if the rate of Pay Television installation in Australia is 200,000 in the first year, there would be approximately

300 people to be employed for installation. If the take-up rate rose to 450,000 then you can double the numbers of installers required," he added.

LOCAL NICAD CHARGERS FOR USA

Peripherals specialist, IPL Datron, has won an American order for 30,000 of its intelligent 'Rapid Charger', a compact NiCad battery recharger designed and manufactured by the company in its factory in the Sydney suburb of Alexandria.

IPL's charger overcomes the 'memory' characteristic of NiCad cells, detecting the exact electrical status of a battery then bringing it up to full charge in an hour, compared with anything up to 10 hours using conventional methods.

The company is a leading distributor in the cellular telephone field and feedback from users highlighted the inherent NiCad weakness. "Anyone using NiCads as a power source, soon becomes aware of the difficulties," said Stead Denton, IPL managing director.

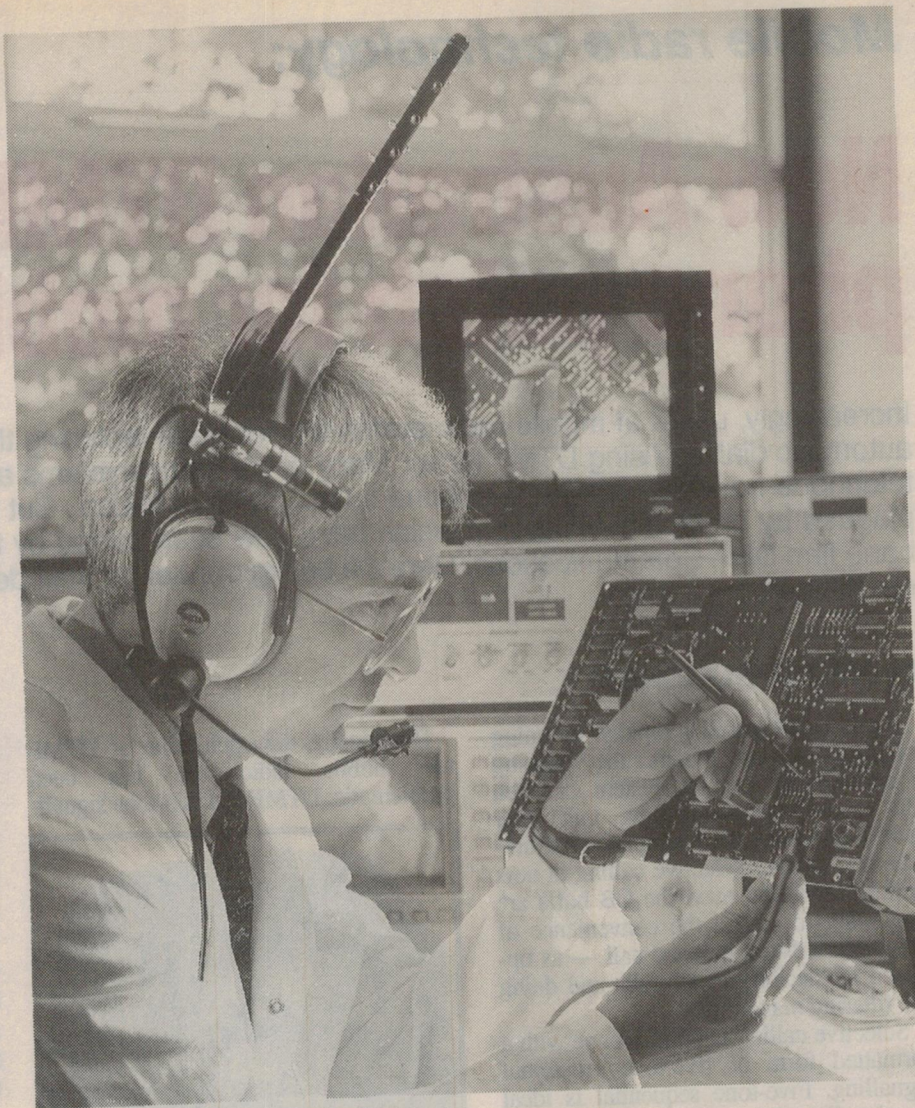
"By developing a practical solution to a worldwide problem, it appears we have a product with great potential in both local and overseas markets. The speedy success of the charger has allowed us to expand our manufacturing facilities, and once we have completed the initial order, we will be capable of producing a further 15,000 each month."

PHILIPS, MOTOROLA SMD JOINT VENTURE

Motorola Semiconductor Products Sector of the US and Philips Semiconductors International of the Netherlands, have agreed to establish a 50/50 joint venture company in Seremban, Malaysia, to assemble small-signal surface mount transistors and diodes. Both companies will provide know-how relating to equipment and processes, and will produce a joint assembly concept for current and future product families.

Construction of a factory in Seremban will start shortly, with initial production being targeted for late 1993. Around 100 people will be employed initially. This number is forecast to rise to more than 500 by 1997, at which time production is expected to be some billions of products annually.

The joint venture, to be called Surface Mount Products Malaysia SDN BHD, represents continued investment in Malaysia's economic development by Philips and Motorola, which plan to put approximately US\$50 million into the venture over the next five years.



The somewhat unusual head gear being worn by this service engineer is an optically coupled video link headset, under development at British Telecom's research laboratory in Martelsham, near Ipswich. The idea of the headset, which combines a video camera and microphone, is to allow experts to demonstrate techniques to people at the remote end of a radio link or telephone line. A surgeon could demonstrate a specialised surgical procedure, for example.

NEWS BRIEFS

- One of the world's largest distributors of computer peripherals, and the largest distributor of Panasonic floppy disk drives, **Ado Electronic Industrial** has begun trading in Australia. Its address is 18/380 Eastern Valley Way, Chatswood 2067; phone (02) 417 5233.
- The **Australian Trade Mission to Israel**, led by Mr Paul Simons will take place on December 13-15. For further details, ring (02) 325 1700.
- **Siemens** has appointed Simon Bailey as Northern Regional (ACT, NSW, Qld) Sales Manager for the Mannesmann Tally range of printers.
- **VSI Promark Electronics** is now the Australian distributor and representative of NT Quartz Crystals — formerly STC Components.
- **Columbia TriStar Hoyts**, part of the Sony group, has appointed Mr Rick Morse as National Retail Manager for Home Video. His role will embrace all areas not specifically associated with half-inch pre-recorded rental tapes.
- The Japanese Advantest Corporation has appointed **Elmeasco Instruments** as its sole Australian agent.
- **ASD'92**, the Australian Software Development conference and expo will be held at the Sydney Hilton from 25- 27th November. This is the first software development conference to be held in Australia, and will become an annual event. For more information, ring (03) 795 3666.
- The **ACOFT-17 '92** optical fibre technology conference will be held at the Wrest Point Hotel Casino in Hobart, from 29th November to 2nd December. For more information, phone (02) 327 4822.

Mobile radio technology:

New Australian DTMF mike & phone patch for mobile radio

Increasingly, users of mobile radio systems have been replacing the old manual 'over' system with automatic dialling using DTMF tones. Many of the same systems are also being linked to the public telephone network, using a telephone interconnect or 'patch'. But both of these moves have been plagued by problems — most of which have now been solved by two products developed by Brisbane firm DNA Communications. Here's a background on their development, written by the designer himself.

by NEIL J. BOUCHER

Basic mobile radio is rapidly becoming a thing of the past. Whether they're using a community repeater system or even CB, users are demanding that their radios do more than simply communicate one-to-one. Selective calling is now widely used, and even the CB buffs are beginning to realise the convenience of being alerted to a directed call — as opposed to listening to all calls and doing the filtering manually.

Selective calling is usually done with a formatted form of five-tone sequential signalling. Five-tone sequential is ideal for signalling in a system with poor signal-to-noise ratio, but it is the structured formatting into groups of five digits that makes this signalling system not particularly suitable for dialling telephone numbers — which can be of any length.

A telephone interconnection greatly increases the utility of a mobile radio system. Instead of just being able to talk to users in the common frequency group, it is possible to connect to any land-line, and indeed to any other mobile system which has interconnect facilities, as can be seen in Fig.1.

Telephone interconnection, despite its obvious advantages, has also had some problems. First, the cost in Australia of well over \$1000 for an interconnect unit or 'patch' has been a limiting factor. Additionally there has been the awkward adaptations of DTMF (dual tone multi-frequency) signalling to the mobile environment, which has meant that the units were far from user friendly.

As will be seen, Australian company DNA Communications has solved these problems for the first time.

Historically, the application of DTMF for mobile radio use has been problematic. DTMF is a two-tone signal-



DNA Communications' new Mark III DTMF microphone, which uses a special Australian-designed chip to optimise keying parameters for the requirements of mobile radio operation.

ing format designed for the PSTN (public switched telephone network), and is most familiar in the 'tone-dial' phone. Generally the telephone network presents a relatively high quality transmission path,

when compared to the mobile radio environment. The signalling tones are 'in-band' — meaning that they occupy the same frequency spectrum as voice. This means that there is a possibility that the human voice can mimic legitimate codes, at least for short periods.

Because reliable decoding in the telephone network is vital, DTMF decoders deliberately reject signals which are deemed too noisy for reliable decoding, or for which the tones do not appear steadily for a pre-set period.

In the mobile environment these PSTN requirements conspire to make things difficult. Mobiles and noise are almost synonymous, and splatters, 'picket fencing' and interference seem to go hand in hand with mobile communications. SSB, which changes the frequency of the tones (the 'Donald Duck' effect) is so hostile to DTMF that the latter cannot be used with this form of modulation.

The DTMF microphone

Frequency modulation, which is renowned for its high quality transmissions, would seem to be the best medium for DTMF and indeed it is. FM is widely used in commercial two-way radio, as well as in UHF CB.

While DTMF does work well in this medium, one problem has plagued users for the last decade. DTMF signalling is done by pressing the required key on the keypad and then hoping it goes to air. The problem is that when a two-way radio is first keyed up, it takes some time to reach full power. This time can be from a few milliseconds to 100 milliseconds or more. Because of this, a key which is

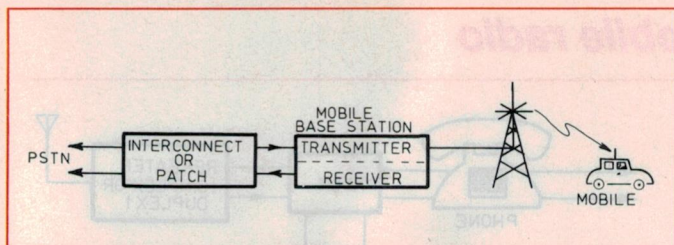
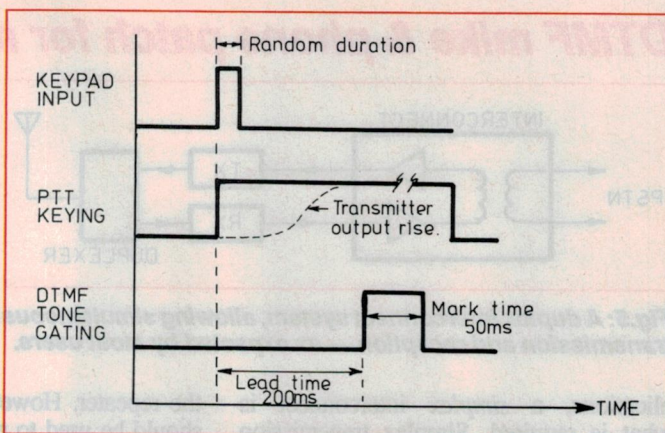


Fig.1 (above): A typical telephone interconnect setup, featuring simplex and duplex capability.

Fig.2 (right): The new DNA microphone includes a custom chip which stores and reformats DTMF keying pulses, allowing for transmitter rise-time and also the need for optimum tone duration in the mobile environment.



pressed briefly may fail to transmit a tone at all, or if transmitted it may be clipped sufficiently so that the decoder at the other end fails to recognise it.

The answer has been to instruct users to dial using the 'public service' technique — that is, very, very slowly. While this is reasonably effective with some users, others just can't seem to get the hang of it and they consistently get wrong numbers. But even so, slow dialling causes a new problem. If the user dials *too* slowly, there is a chance that say a '1' dialled slowly will during the transmission be received by the decoder as '1,1' — due to a local fade which breaks the transmission for long enough to imitate two 1's being dialled in sequence. In fact wrong numbers which contain double or even triple digits-in-error are not uncommon from mobiles.

The answer seems to be to buffer the input keying, regulate the tone and control the mark-space ratio and tone duration. The problem has been that until now, manufacturers of mobile DTMF microphones and encoders have relied exclusively on chips designed for the telephone network. Because the telephone network doesn't have these problems, there are no off-the-shelf chips which can solve this problem.

DNA Communications has on the other hand developed its own chip, which is custom designed for the mobile environment. Each keystroke is buffered and

stored while the radio's PTT line is activated. The tone is sent only after a delay sufficient to ensure that the RF output has risen to full power (Fig.2).

The new chip is called the DNA100, and is at the heart of the new DNA Mark III DTMF microphone (Photo 1). It will soon appear in other models as well, as the chip will be separately marketed, both in Australia and overseas. Fully designed and developed in Australia, the chip features automatic redial, PABX capability and continuous tone capability to facilitate setting deviation.

Lest there be protests that other suppliers have microphones selling at \$200 plus, which have memory to effectively overcome most of the mis-dialling problems, yes these certainly exist. But they don't solve the problem.

Because the processors in these microphones use telephone chips, they have delays and tone periods of only around 50ms, and so are only suitable for the quickest of the interconnect decoders. These are again using chips designed for the conventional telephone network, and have all the problems referred to above when a number is dialled direct.

A new and puzzling problem has been found, during our early trials with the DNA MkIII. Some interconnect systems, which according to their specifications should decode a 40ms tone, after some years of service require as much as 200ms tone duration, and instead of the inter-

digit space of 20ms may require up to 100ms. All of the foregoing occurs even though new units do not appear to have the same limitations.

Needless to say this tends to confuse and frustrate the users, even more than it does the service technicians.

The DNA MkIII comes with four strapable timing formats, which include even the slowest mark-space ratio that has yet been demonstrated.

In spite of the problems, DTMF has remained a major mobile signalling format, mainly because it is so universally available in the telephone network and also because it is so widely used in the USA. The acceptance of DTMF in Australia is growing rapidly, but is still far behind the US.

Once DTMF is provided on a system, it can be used for many purposes. Apart from telephone interconnection, one of the most useful applications — particularly in rural areas — is the ability to operate devices remotely. Applications include lighting systems, water pumps and valves, gates and generators.

The cost can be kept minimal, as in rural areas CB radio (especially UHF) has plenty of spare channels. Purpose-built DTMF decoders with from one to 16 outlets are available for these purposes.

Interconnects

Telephone interconnects or 'patches' come in three basic types. For most ap-

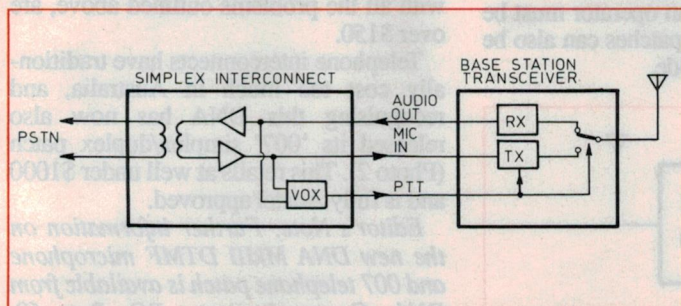


Fig.3: A basic simplex interconnect system. This uses a VOX circuit to key the transmitter's PTT line.

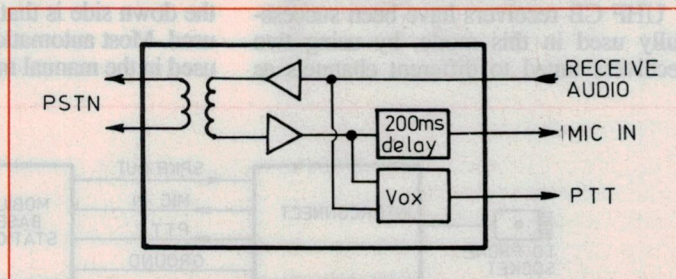


Fig.4: By adding a delay of around 200ms to the transmit circuit, the transmitter's finite rise-time can be prevented from clipping the first syllable of each message.

DTMF mike & phone patch for mobile radio

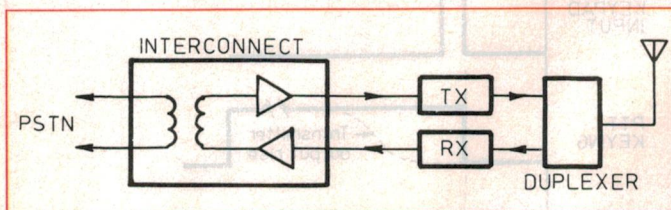


Fig.5: A duplex interconnect system, allowing simultaneous transmission and reception — as expected by most users.

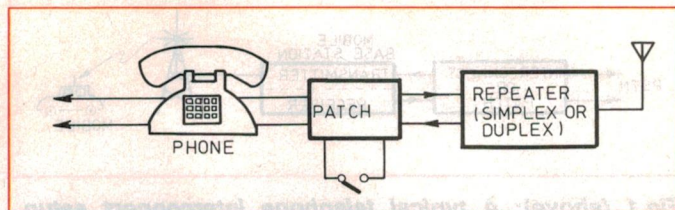


Fig.6: A manual interconnect system. No DTMF coding or decoding is required, but a manual operator must be present.

plications, a *simplex* interconnect is what is required. Simplex transmission is associated with bases that operate in the simplex mode — i.e., the mobile either transmits or receives, but not both simultaneously.

This is commonly the case with CB and small private two-way systems. Simplex interconnects are in fact more complex than duplex, because once again the rise time of the transmitter becomes a problem.

As seen in Fig.3, the simplex interconnect must not only connect the mobile to the telephone network but it must also control the PTT on the mobile through a VOX (voice-operated switch). The VOX continuously monitors the voice level of both the mobile and the telephone line, and makes the decision to switch accordingly to the relative levels.

Because the decision to switch to the mobile takes time and because of the RF stage rise time, a simple VOX as depicted in Fig.3 will result in the clipping of the first syllables of each word.

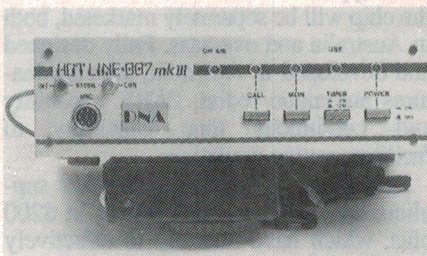
This can be prevented by the inclusion of a delay between the telephone line and the transmitter, which allows the transmitter to rise to full output before the voice is sent (Fig.4). Delays from 100-250ms are commonly used.

A *duplex* interconnect is shown in Fig.5, and as you can see this is inherently much simpler, because there is no switching in the repeater. A duplexer (an RF isolation device) is connected between the receiver and transmitter antennas, to enable them to operate simultaneously.

UHF CB receivers have been successfully used in this mode, by using two receivers tuned to different channels as

the repeater. However separate antennas should be used to prevent one set desensitising the other. Duplexers are hard to come by (or expensive) for CB bands, and the alternative of using a separate antenna for the transmitter and receiver, well separated (by at least 10 wavelengths horizontal separation, or a metre exactly vertical), is equally effective.

A duplex interconnect is recommended



DNA has also produced this new '007' telephone interconnect unit, which is fully Austel approved yet sells for under \$1000.

where the mobile is frequently used to contact the general public, who will find simplex mode difficult to adjust to. Increasingly, duplex is being used by out-back taxis (who often complain that the background noise from the car locks up a simplex VOX), and by real estate agents.

A third type of interconnect that is strictly *manual* is often used by amateurs. Because a manual 'patch' does not have a DTMF decoder, a telephone must be used in parallel as seen in Fig.6.

This means of course that the mobiles no longer need DTMF generators — but the down side is that an operator must be used. Most automatic patches can also be used in the manual mode.

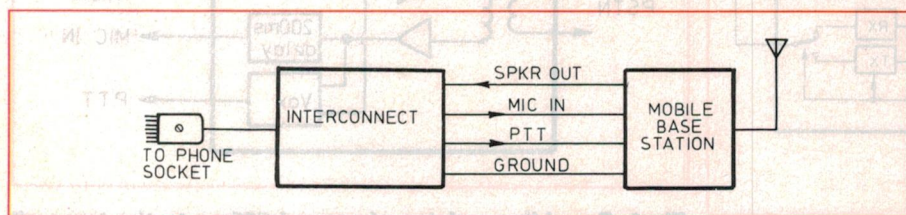


Fig.7: The connections between a mobile base station and a telephone interconnect are usually quite straightforward.

Setting up a patch

Setting up an interconnect is relatively simple. As can be seen in Fig.7, there are essentially only four wires from the base station to the interconnect: a receive audio-out link (often the speaker line), the microphone input, the microphone PTT line and the earth. Note that if any point after the volume control is used for the receive audio take-off, then the user of the mobile will disturb the set-up levels by using that control.

Connection of the interconnect to the telephone network is very simple, because type-approved units will come with a standard Telecom plug.

It is important to note that Austel takes a very dim view of the attachment of non-approved devices to the network, and there is a fine of up to \$12,000 for doing so. Before purchasing any interconnect device it is important to check that it is type approved, and that the type-approval sticker is attached to the unit. It is NOT sufficient that a type-approved telephone line interface is used in conjunction with the interconnect, unless that device is part of the approval of the interconnect.

The bottom line

With the problem of making DTMF work properly in the mobile two-way radio environment solved, only one problem remains: the cost.

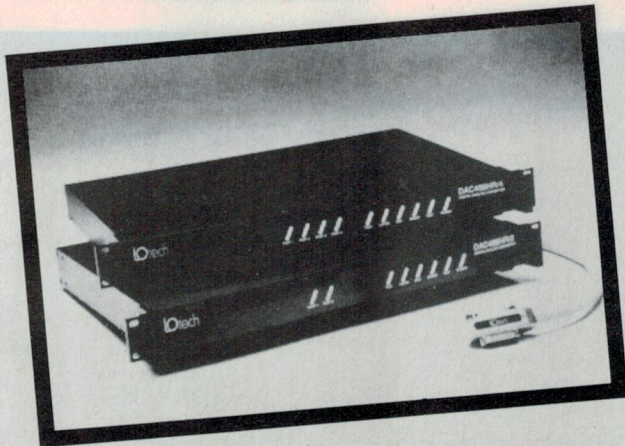
The new DNA MkIII microphone will retail for less than \$200, which is not bad when you consider that the old style units, with all the problems outlined above, are over \$150.

Telephone interconnects have traditionally cost too much in Australia, and recognising this DNA has now also released its '007' simplex/duplex patch (Photo 2). This retails at well under \$1000 and is fully Austel approved.

Editor's Note: Further information on the new DNA MkIII DTMF microphone and 007 telephone patch is available from DNA Communications, PO Box 69, Broadway, Brisbane 4006; phone (07) 862 1929.

PRODUCT HIGHLIGHT — New from 10tech

IEEE 488.2, 100 kHz, 16-Bit Multichannel DAC



The 100kHz, 16-bit DAC 488HR digital to analog converter (DAC) offers IEEE 488.2 programmability and up to 4 isolated analog output channels in a 1.75-inch rack-mountable package. The unit features the capabilities of several traditional IEEE 488.2 instruments at a fraction of the cost. For example the DAC488HR's step, burst, waveform, and continuous-trigger modes enable it to provide stepped voltages like a precision voltage source, long arbitrary waveforms like an arbitrary waveform generator, or sine, triangle square, and sawtooth functions like a function generator.

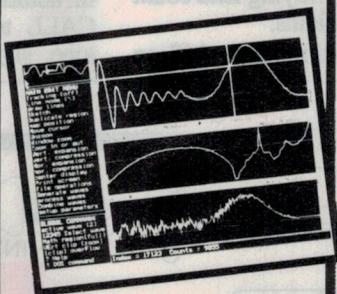
High Resolution, Multiple Channel Analog Output

Unlike function generators and other signal source instruments, which typically provide only one output channel, the DAC488HR offers either 2 or 4 electrically isolated output channels, making it ideal for applications that require multiple channels that can operate synchronously. Similarly, in contrast to the 8- or 12-bit resolution provided by function generators, the DAC488HR offers 16-bit resolution, making it ideal for

use in amplitude-critical, audio-frequency applications.

Independent Buffer Management

The DAC488HR features an 8 K sample/channel buffer that is optionally expandable to either 128 Ksamples or 480 Ksamples/channel. Waveforms can be loaded into the DAC488HR's resident buffer from the IEEE488 bus at up to 400Kbytes/ second, minimizing the data transfer time necessary to load large waveforms into its memory. For applications that require high speed output of very large waveforms, such as audio testing and speech research, the DAC488HR can continuously output data from the IEEE 488 bus to a digital to analog converter channel at 100 Ksamples/second.



*R4 software
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for generation by
the DAC488HR*

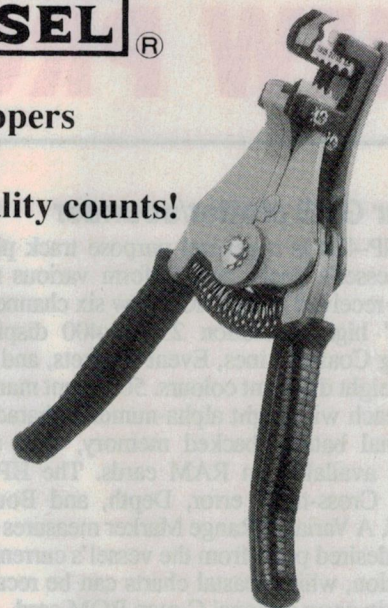


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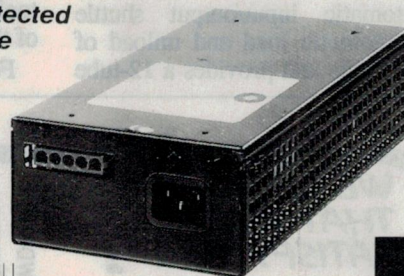
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NEW PRODUCTS

Colour GPS plotter/sounder

The NP-420 is a general purpose track plotter, designed to plot a vessel's tracks and perform various navigational computation received from JMC's new six channel GPS sensor.

A 10" high resolution 256 x 400 display shows tracks, Lat/Long Coastal Lines, Event Markets, and other information in up to eight different colours. 500 event marks, and 1000 track points, each with eight alpha-numeric characters can be stored in internal battery backed memory, with additional storage capacity available on RAM cards. The NP-420 has Arrival, Anchor, Cross-track error, Depth, and Boundary Alarms as standard. A Variable Range Marker measures distance and bearing to a desired point from the vessel's current position or a cursor position, while coastal charts can be recalled from internal ROM chip or an optional C-map ROM card.

The NP-420 can be used as a full function colour Echo Sounder, with a powerful 2kW (28/38/50/200kHz) transmitter board and ranges from 5m to 2000m, with full screen presentation. Split screen is also available for bottom and mid-water expansion.

A printer interface is also incorporated, which allows a Canon Colour-Ink Jet Printer to print the current screen status and echo sounder pictures in full eight colours. An IBM graphic printer may also be connected to produce black and white hard copy.



For further information circle 241 on the reader service coupon or contact Navtronics, Lot 5, Gateway Drive, Labrador 4216; phone (075) 37 9200.

Lead straightener

American Tech Manufacturing has released a new Model, the AT-2000 SOJ Lead Straightener which reconditions pin-to-pin distance, coplanarity, and body offset for SO 'J' leaded devices. This machine incorporates many features similar to those found on the AT-1000 SOIC gull wing lead straightening system.

An automatic input/output shuttle provides automatic load and unload of SOJ components and provides a 12-tube

capacity. Quick change tooling accommodates various package widths. Standard tooling handles 0.300" wide SOJ.

The software features a 2 x 20 character vacuum fluorescent display, plus real-time digital readouts for air pressure and critical mechanical adjustments (body height and sweep). There is digital readout for all sensor voltages, and a manual mode for reading and changing the state of each valve. No additional tooling is required for varying lead count of the same package widths.


For further information circle 245 on

the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

1GHz signal generator

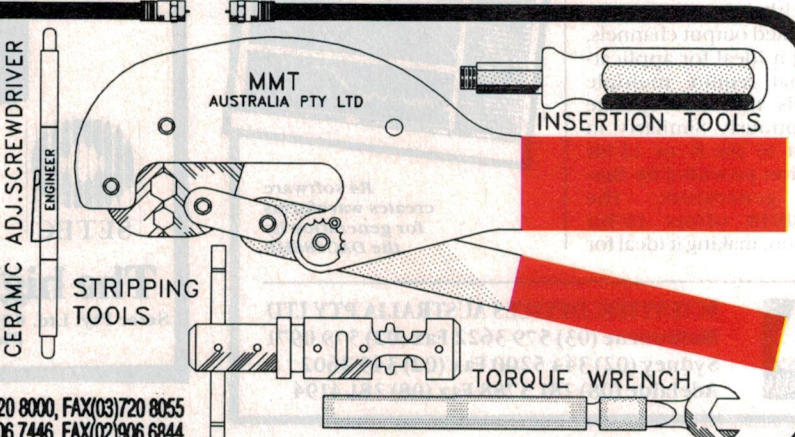
A new portable RF signal generator from Farnell Instruments, the PSG1000B, covers the range 10kHz to 1GHz, and adds several new features to those of its predecessor, the PSG1000. In addition to providing standard SEL-CALL tones, it caters for proprietary tone signalling systems by allowing

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up to 16 user defined tone frequencies and durations.

To aid component testing of items such as crystal filters, Farnell has included a sweep ramp output for synchronising and driving an external DSO.

A separate low impedance modulation output means that the PSG1000B may be used as an audio generator capable of driving a 50 ohm load. And, to simplify operations such as the manual testing of IF bandwidth, an assignable rotary control has been added to the instrument's front panel. The FM modulation bandwidth has been increased to 100kHz, with deviations up to 1.6MHz.

The RF synthesiser and RF output sections of the instrument are housed in double screened enclosures with costly feed-through interconnections minimised by use of serial data links.

For further information circle 243 on the reader service coupon or contact Elmeasco, PO Box 30, Concord 2137; phone (02) 736 2888.

Pocket sized F-O tester

Black Box Catalog has just introduced a flexible, cost effective, pocket sized Fibre Optic Tester, allowing technicians to test light losses or locate individual cables in the electrical and communications

wiring schemes in buildings. The unit is specifically designed to provide computer installation and maintenance crews with a quick check facility for cable reliability by measuring light intensity and loss along cable lengths.

The user simply connects the test to any SMA905 or ST type cable and takes a reading on the unit's calibrated LED scale. Light energy loss over the length of the cable is estimated by subtracting the reading from -20dBm, the intensity of the unit's light source.

For further information circle 247 on the reader service coupon or contact Black Box Catalog, PO Box 248, Croydon 3136; phone (03) 879 7100.

Data radios

McLean Automation has developed an OEM kit for outfits wishing to dabble in affordable short haul radio telemetry without investing in a complete packet radio system.

Containing a pair of radio licence exempt digital wireless transceivers, two high quality ground plane independent antennas and brief instructions, the kits are designed for organisations familiar with digital techniques but not wishing to get their feet wet at the RF end of the pool.

Based on card level product identical to that used by the sourcing company in their TNCs and RTUs, the units can be teamed with a microprocessor or PLC for telemetry only applications, or used with a range of compatible inexpensive ASIC-based boards for short range remote control.

For further information circle 242 on the reader service coupon or contact McLean Automation, 364 Terrace Road, Freemans Reach 2756; phone (045) 79 6365. ♦



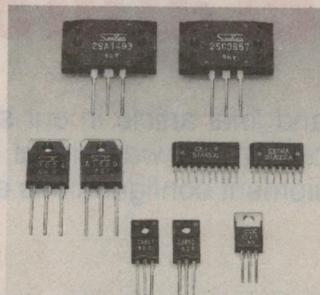
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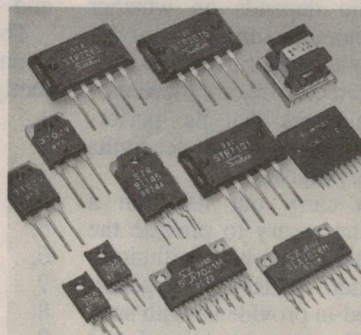


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Technology update:

Modern RF Signal Generators & their use - 3

In this third and final article in our series adapted from a seminar by engineers at Marconi Instruments, we look at the way signal generators are used to evaluate the performance of a radio receiver. Equipment configurations and test procedures are given for all main receiver performance parameters.

Typical receiver measurements may be split into those which only require one signal generator, and those using two or more. They may also be divided into *in-band* tests involving signals in the required channel only, and *out-of-band* tests which include the effect of signals in unwanted channels.

The number and type of tests carried out on a radio depends on whether development, manufacturing or servicing of the radio is being carried out. The tests to be described here, are those normally used to check that the performance of a receiver is within set limits for any of these purposes.

In order to carry out tests on a receiver, it is necessary to provide the receiver with a signal which will simulate a transmitter. An RF signal generator can be used to provide us with such a signal, which must be 'clean' and which we can vary in both frequency and level. The signal generator must also be capable of modulating the carrier in the desired way: AM, FM or ϕ M.

The choice of signal generator type will be dependent on the type of work being carried out. During routine servicing work, a low cost model may well prove to be adequate.

In production areas where greater accuracy and stability are of importance — along with a good degree of signal

purity, repeatability and possibly the need to control the instrument as part of an automated test system — it is clear that a more expensive signal generator is required.

In some development areas it may be necessary to use a cavity tuned oscillator to provide a spectrally purer signal, eliminating the effects of spurious and harmonics.

The tests which should be carried out to ensure that a receiver is operating correctly are listed below:

1. Sensitivity
2. Signal to noise ratio
3. IF bandwidth
4. Modulation acceptance bandwidth
5. Audio frequency response
6. Distortion
7. Selectivity
8. Unwanted response rejection
9. Blocking

Of those listed above, probably the most important single test is the sensitivity test.

1. Sensitivity

The sensitivity of a receiver, together with the transmitter frequency and power, will determine the maximum operating range of a radio system.

Sensitivity is defined as the minimum RF level required at the antenna to produce an intelligible audio output. The

problem then becomes one of deciding: what is an intelligible output?

This is really a rather subjective decision, so sensitivity has to have certain parameters set down. It is commonly specified in any one of four ways; these are as follows:

- a) Maximum sensitivity
- b) Noise limited sensitivity
- c) Usable sensitivity
- d) Quieting sensitivity

All sensitivity tests involve varying the RF level at the antenna to produce a given audio output.

Maximum sensitivity (gain limited sensitivity: This is the RF input level required to produce a given audio power output (usually 50mW). This applies only to AM receivers.

The method of measurement is as follows:

- i) Connect the equipment as shown in Fig.3.1.
- ii) Increase the receiver volume gain control to the maximum.
- iii) Set the signal generator to produce 30% AM depth with a modulating frequency of 1kHz.
- iv) Adjust the RF level until the receiver output is 50mW.

Noise limited sensitivity: In this sensitivity measurement test, we are looking for a 10dB difference between the audio power level with the transmitter

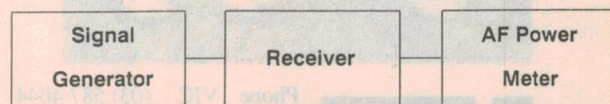


Fig.3.1: Maximum sensitivity

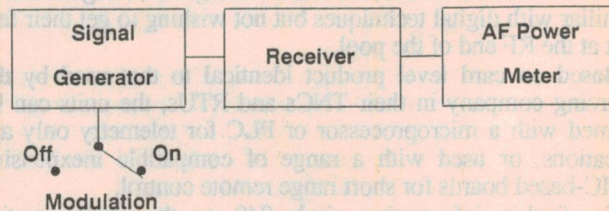


Fig.3.2: Noise limited sensitivity

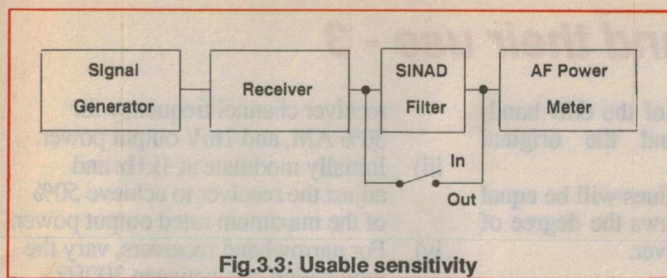


Fig.3.3: Usable sensitivity

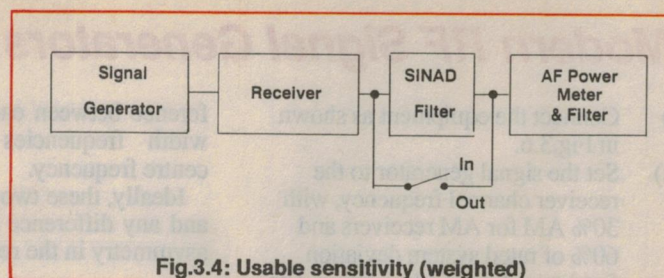


Fig.3.4: Usable sensitivity (weighted)

modulation switched off, and with it switched on. One of its major drawbacks is that it assumes that the audio distortion caused by the receiver is insignificant, so a receiver could pass this signal to noise ratio (S/N) sensitivity test, but the signal could still be of low quality.

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.2.
- ii) Set the RF signal generator to the receiver channel frequency and 60% of the rated system deviation for narrowband FM receivers, 30% AM for AM receivers and 22.5kHz deviation for FM broadcast receivers.
- iii) Set the modulation rate to 1kHz.
- iv) With the modulation switched on, adjust the receiver volume control to achieve 50% of the rated output power.
- v) Switch the modulation off and adjust the RF level to give a reading 10dB below that achieved with the modulation on.
- vi) The RF level is the 10dB signal-to-noise sensitivity level for narrowband receivers. A 20dB signal to noise sensitivity level is used for broadcast receivers.

S/N can be regarded as:
 $20\log_{10}((S+N+D)/N)$ dB.

Usable sensitivity:

This method of checking the receiver sensitivity is considered to be one of the more meaningful. This is because it takes into account the effects of audio distortion on the intelligibility of the received signal.

A value of 12dB is now taken as the usable sensitivity, based on a statistical

breakdown of subjective measurements of intelligibility, expressed as a mean opinion score.

The measurement method here is:

- i) Connect the equipment as shown in Fig.3.3.
- ii) Set the receiver's squelch level to minimum before carrying out a sensitivity test.
- iii) Set the RF signal generator to the receiver frequency with the modulation set to give 60% of the maximum rated system deviation for FM receivers, 30% modulation depth for AM receivers and a 1kHz modulation rate.
- iv) With the SINAD (1kHz notch) filter switched out, adjust the volume control for 50% of the rated output power.
- v) Switch in the SINAD filter.
- vii) Adjust the RF level to achieve a reading of 12dB down from that without the filter.
- viii) The setting of RF level on the signal generator is the 12dB SINAD sensitivity level of the receiver.

SINAD can be regarded as:

$20\log_{10}((S+N+D)/N)$ dB.

Usable sensitivity (weighted): This test is basically the same as the 12dB SINAD test, the differences being that an extra, non-switchable weighting filter is inserted before the input to the AF power meter, and that the ratio is adjusted to 20dB, instead of 12dB, to compensate for the smaller bandwidth being measured (Fig.3.4).

The extra filter normally used is a telephone 'psophometrically-weighted' filter (either CCITT or C-MESS), which

simulates the response of a human ear, or a CCIR filter which is used in broadcasting. The purpose of these is to allow a more accurate measurement of the 'true-life' sensitivity.

The two standards, CCITT and C-MESS (European and American respectively), are in fact slightly different, although they are supposed to be definitions of the same response.

Quieting sensitivity: This sensitivity measurement is unique to FM receivers, since when an unmodulated signal is applied, the noise in the audio stages of the receiver reduces as the RF level is increased. Quieting sensitivity is defined as the input level which causes the receiver noise output to reduce by 20dB.

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.5.
- ii) Set the RF signal generator to the receiver channel frequency, with the modulation switched off.
- iii) Switch off the carrier.
- iv) Adjust the receiver volume control to achieve a reading of 50% of the rated output power.
- v) Switch the carrier on, and increase the RF level from the signal generator so that you achieve an AF level 20dB lower than that achieved in (iv).
- vi) The RF setting on the signal generator is the quieting sensitivity level for that receiver.

2. Signal to noise ratio (S/N)

This test is similar to that for sensitivity, but gives a measure of the overall quality (fidelity) of a signal at a given high output level.

The method of measurement is:

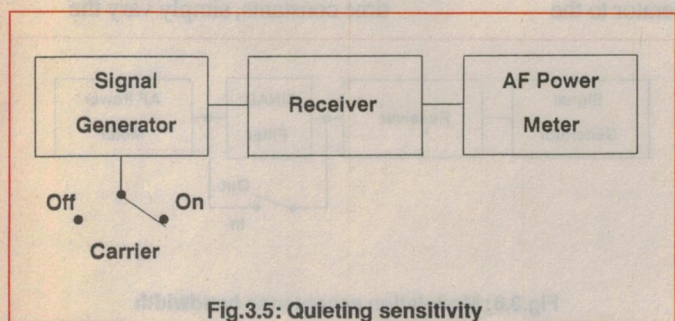


Fig.3.5: Quieting sensitivity

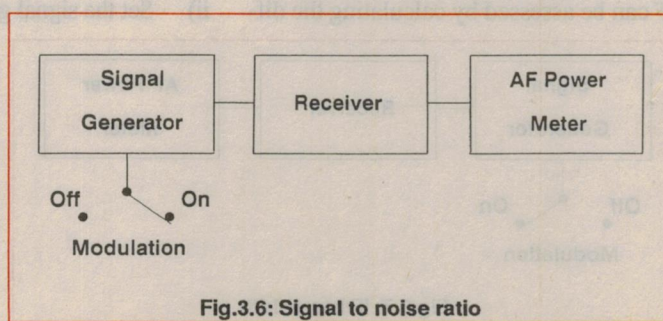


Fig.3.6: Signal to noise ratio

Modern RF Signal Generators and their use - 3

- i) Connect the equipment as shown in Fig.3.6.
- ii) Set the signal generator to the receiver channel frequency, with 30% AM for AM receivers and 60% of rated system deviation for narrowband FM receivers. For stereo receivers the measurement must be made with a stereo coded modulation signal.
- iii) Modulate at a 1kHz rate.
- iv) Set the signal generator output to 1mV.
- v) Measure the S/N ratio — that is, the ratio of audio output with the modulation switched on and off.
- vi) Weighted S/N measurements are also made with either a CCITT (narrowband receivers) or CCIR (broadcast receivers) filter inserted before the AF power meter.

3. IF Bandwidth

This is an indirect method of measuring the IF bandwidth of the receiver. For AM, more accurate measurements are made by monitoring the DC output of the detector whilst the input frequency is varied.

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.7.
- ii) Set the signal generator to the receiver channel frequency, 30% AM for AM receivers and 60% rated system deviation for narrowband FM receivers.
- iii) Modulate at a 1kHz rate.
- iv) Adjust the RF level output of the receiver until signal to noise ratio of 10dB is achieved in the receiver output.
- v) Increase the RF level output by 6dB (that is, double it) and re-tune each side to the two frequencies where the S/N ratio again falls to 10dB.
- vi) The difference between the two frequencies is an approximation to the receiver bandwidth.

Note that the symmetry of the receiver IF can be assessed by calculating the dif-

ference between each of the 6dB bandwidth frequencies and the original centre frequency.

Ideally, these two values will be equal and any difference shows the degree of asymmetry in the receiver.

4. Modulation acceptance bandwidth

This is specifically applied to narrowband FM receivers, and is a measure of the FM deviation the receiver will accept at an RF input level 6dB above the measured usable sensitivity.

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.8.
- ii) Set the signal generator to the receiver channel frequency, with 60% of the rated system deviation and modulate at a 1kHz rate.
- iii) Adjust the RF level to produce 12dB SINAD at the receiver output (with an output power of 10% of the rated maximum).
- iv) Increase the generator output by 6dB and increase the FM deviation until the SINAD ratio returns to 12dB. Under these conditions, the deviation produced by the signal generator is the modulation acceptance bandwidth.

Note that the modulation acceptance bandwidth should be greater than the rated system deviation for which the receiver is designed.

5. AF response

The AF response shows the bandpass characteristic at the output of the receiver, generally designed to be complementary to that of the associated transmitter.

It is easily tested by applying a signal from the generator and noting the variation in receiver output as the modulating frequency is varied.

The method measurement is:

- i) Connect the equipment as shown in Fig. 3.9.
- ii) Set the signal generator to the

- iii) receiver channel frequency for 30% AM, and 1mV output power.
- iii) Initially modulate at 1kHz and adjust the receiver to achieve 50% of the maximum rated output power.
- iv) For narrowband receivers, vary the modulation rate between 300Hz and 3kHz. Broadcast AM receivers should be tested over a wider modulation range of, for example, 20Hz to 5kHz. Note the AF output power at specific modulation rates.

- v) Plot the results on a graph.

Narrowband FM receivers:

- ii) Set the signal generator to the receiver channel frequency, 20% of the rated system deviation and 1mV output power.
- iii) Initially modulate at 1kHz and adjust the receiver to achieve 50% of the maximum rated output power.
- iv) Vary the modulation rate between 300Hz and 3kHz. Note the AF output power at specific modulation rates.
- v) Plot the results on a graph.
- vi) Note that relative to the output at 1kHz, the response falls at 6dB/octave (20dB/decade). This is due to the 750us de-emphasis time constant for narrowband receivers. To take account of this, introduce pre-emphasis into the signal before input to the receiver by applying the equivalent phase modulation to the signal generator, instead of FM and then repeat steps 2 and 5.

Broadcast FM receivers:

- ii) Set the signal generator to the receiver channel frequency and 1mV output power.
- iii) Modulate with a stereo encoded signal, $L = R = 1\text{kHz}$ and the pilot tone at 19kHz, and adjust the receiver to achieve 50% of the maximum rated output power.
- iv) Since the stereo encoder will contain the necessary pre-emphasis time constants, simply vary the

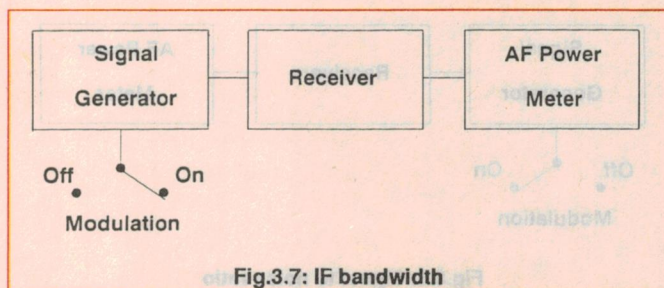


Fig.3.7: IF bandwidth

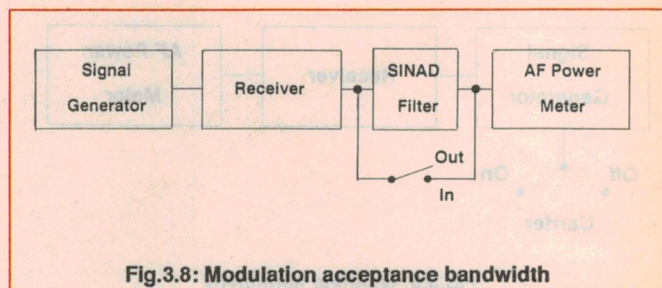


Fig.3.8: Modulation acceptance bandwidth

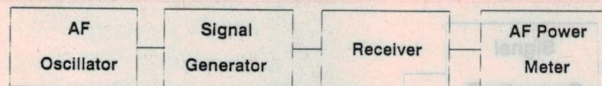


Fig.3.9: Audio frequency response

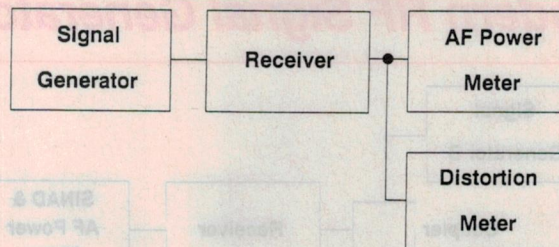


Fig.3.10: Harmonic distortion

source frequency in the encoder from 30Hz to 15kHz, noting the AF output power.

- v) Plot the results.

6. Distortion

Distortion measurements at full rated output power levels are sometimes made, as a means of determining the maximum useful output power. But more meaningful measurements are obtained at lower output levels as they are more representative of normal operating conditions (output between 10% and 50% of the maximum rated power are often used).

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.10.
- ii) Set the signal generator to produce an RF output of 1mV with 30% AM for AM receivers and 60% of the rated system deviation for FM receivers.
- iii) Adjust the volume control for the required output (10% - 50% of the maximum rated output power).
- iv) The distortion meter reading shows the distortion value.

Note that broadcast FM receivers will be tested with a stereo encoded modulation signal and the distortion present in each channel may be measured separately. Since a distortion meter responds to hum and noise as well as harmonic distortion, it is sometimes preferable to use a spectrum analyser to monitor the AF output and to note the levels of the individual harmonics. Here the total harmonic distortion is given by:

$THD = (100[\sqrt{V_2^2 + V_3^2 + V_4^2 + \dots}]/V_1)\%$
where V_1 is the level of fundamental signal, and V_2, V_3, V_4 etc., are levels of the harmonics.

7. Selectivity

The measurements described up until now have all used the signal generator tuned to, or around, the nominal centre frequency of the receiver, and are usually described as 'on channel' tests. However, the response of a receiver to interfering signals is an important measure of its ability to operate in 'real' conditions, where a wide range of signals at other frequencies are present.

Selectivity can be seen as the capability of a receiver to detect a lower level *wanted* signal in the presence of a higher level *unwanted* signal.

This sort of situation can occur when a mobile receiver is operating on or near the limit of its base station's catchment area, and another transmitter is operating nearby.

Adjacent channel rejection: The IF filter bandwidth gives an indication of the selectivity of the receiver, but often it is necessary to test this more precisely.

The adjacent channel rejection demonstrates the receiver's ability to reject an interfering signal on the next channel and is performed with two signal generators connected together, using a directional coupler.

A coupler should always be used where level differences of more than 90dB are likely to be encountered, but below this level a star network may be used.

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.11.
- ii) Set signal generator B to the next channel frequency (above or below the wanted channel), 30% AM or 60% of the rated system deviation for FM receivers, and modulate at a 400Hz rate.
- iv) Adjust the output of signal generator A to the usable (12dB) SINAD level and the receiver output to 50% of its maximum rated output power.
- v) Initially reduce the level of signal generator B to a minimum output level.
- vi) Increase the output of signal generator B until the SINAD ratio falls to 6dB and note this level.
- vii) Repeat steps 1 to 6 for signal generator B tuned to the other adjacent channel.
- viii) Take the ratio in dB of the level of B to A. That is:
 $B/A = 20\log_{10}(U_s/W_s/\text{dBm})$,
where U_s is the unwanted signal and W_s is the wanted signal.
- ix) The lowest of the two values is specified as the adjacent channel selectivity.

Alternate channel rejection: This measurement is similar to that of adjacent channel, with signal generator B tuned *two* channels away from the wanted channel, instead of to the adjacent channel.

Co-channel rejection: The co-channel rejection is a measure of the

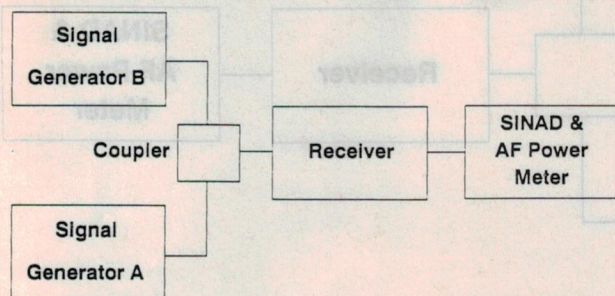


Fig.3.11: Selectivity

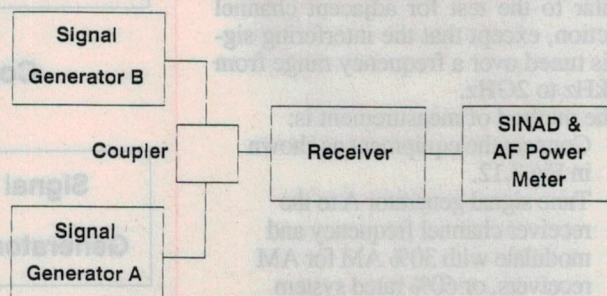


Fig.3.12: Spurious response rejection

Modern RF Signal Generators and their use - 3

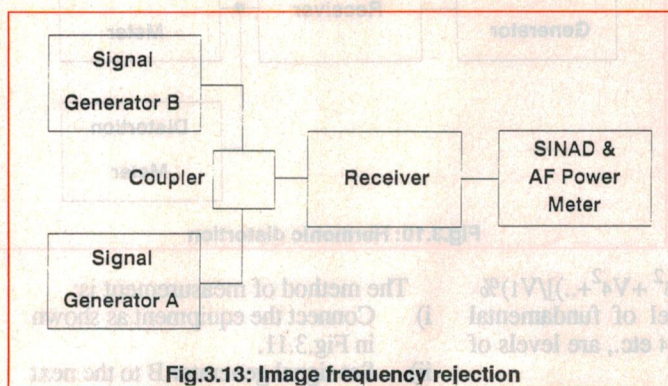


Fig.3.13: Image frequency rejection

capability of a receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

The method of measurement is:

- Connect the equipment as shown in Fig.3.11.
- Set signal generator A to the receiver channel frequency, 60% of the rated system deviation for FM receivers or 30% AM, and a 1kHz modulation rate.
- Set signal generator B to the receiver channel frequency, 60% of the rated system deviation for FM receivers or 30% AM and a 400Hz modulation rate.
- Adjust the output power of signal generator A to the usable (12dB) SINAD level.
- Reduce the level of signal generator B to a minimum.
- Increase the RF level of signal generator B until the SINAD value is reduced to 6dB.
- Co-channel selectivity = $20\log_{10}$ (Unwanted signal / Wanted signal) dB.
- Repeat the measurement for displacements of the unwanted signal of up to ± 3 kHz.

8. Unwanted response rejection

Spurious response rejection: This is similar to the test for adjacent channel rejection, except that the interfering signal is tuned over a frequency range from 100kHz to 2GHz.

The method of measurement is:

- Connect the equipment as shown in Fig.3.12.
- Tune signal generator A to the receiver channel frequency and modulate with 30% AM for AM receivers, or 60% rated system deviation for FM receivers with a 1kHz tone.

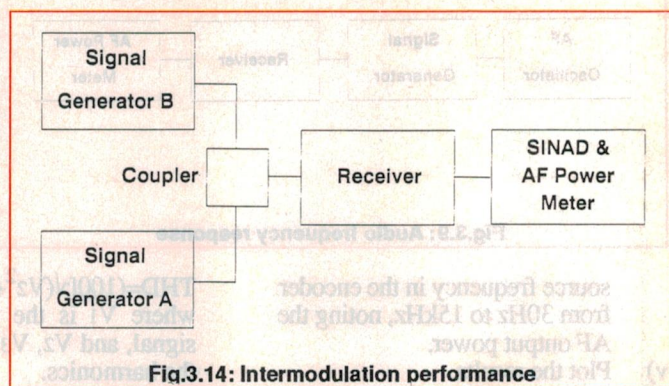


Fig.3.14: Intermodulation performance

- Set signal generator B to the same modulating conditions, but with a 400Hz modulating tone.
- Adjust the RF output of signal generator A to the 12dB SINAD level.
- Adjust the RF output of signal generator B to a level 80 to 90dB above the level of signal generator A.
- Vary the frequency of signal generator B from 100kHz to 2GHz. When a response is found (that is, a significant change in the SINAD ratio), stop the search.
- Adjust RF output level of B until 6dB SINAD is achieved. Note the generator frequency and the output level relative to the in-channel generator output noted.
- Plot the results.

Note that responses at frequencies which are sub-multiples of the receiver input frequency are ignored, as these are normally caused by signal generator harmonics. Response at frequencies between the adjacent channel frequencies should also be excluded.

Image frequency rejection: This is a measure of the ability of the receiver (normally a superhet), to reject the

image frequency which is twice the IF away from the tuned frequency at which the receiver was designed to work.

The method of measurement is:

- Connect the equipment as shown in Fig.3.13.
- With signal generator B switched off (or left at minimal output level) set up signal generator A to produce a 12dB SINAD at the output of the receiver with a 1kHz modulating tone.
- Tune signal generator B to the image frequency (twice the IF from the carrier) selecting a 400Hz modulating tone and an FM deviation of 60% of the system deviation.
- Increase the level of signal generator B until 6dB SINAD is achieved.
- The image frequency rejection ratio is given by the difference in levels between generator A and generator B, in dB.

Intermodulation performance: If the front end of the receiver is non-linear, signals at the input will mix to form intermodulation products, and it is possible that one of these may be at the

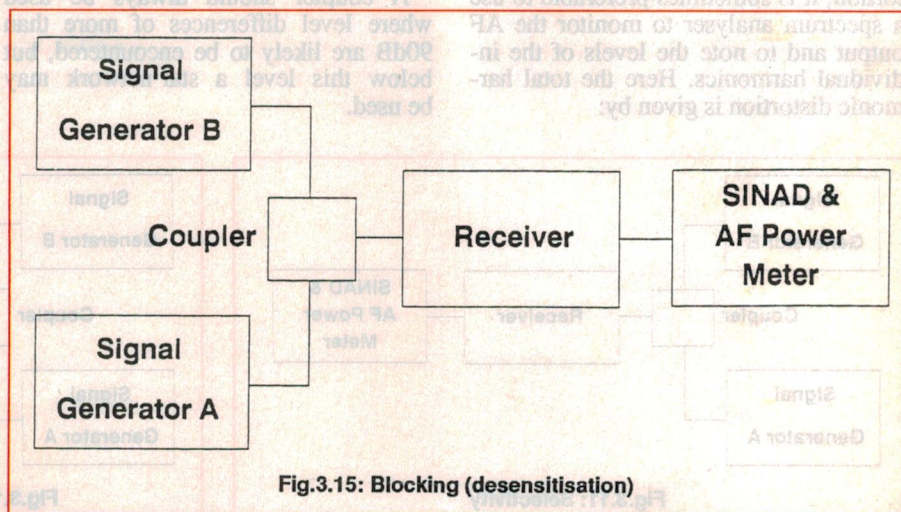


Fig.3.15: Blocking (desensitisation)

on-channel frequency, in which case the receiver will respond to it.

The intermodulation product frequencies are given by the equation:

$$f_r = nf_1 \pm mf_2$$

where: n and m are two different multipliers with values of 1, 2, 3, 4...etc., and f₁ and f₂ are intermodulating frequencies.

This test, which can be performed using two or three signal generators, measures the ability of the receiver to inhibit the generation of in-band modulating signals caused by the presence of two signals at unwanted frequencies combining to cause intermodulation products. It should be remembered that any values of n and m can produce a response.

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.14.
- ii) Set signal generator A to the receiver frequency and modulate with a 1kHz tone. Adjust the output level to give a 12dB SINAD at the receiver output and note this value.
- iii) Reset generator A to a frequency that is eight channels higher than the wanted frequency and generator B to a frequency four channels higher than the wanted frequency. Generator B is left unmodulated, whilst generator A is modulated with a 400Hz tone at 60% of the system deviation (30% AM depth).
- iv) Set both generators to produce equal output levels and increase these simultaneously until a 12dB SINAD ratio is again achieved on the wanted channel, due to the intermodulation.
- v) The Intermodulation Response Rejection Ratio, or IRRR is given by:

$$IRRR = 20 \log_{10} (\text{Final generator setting} / \text{Original setting}) \text{dB.}$$

Note that it is obviously important to make sure that the output levels of A and B are kept the same, as a small difference between them can have a large effect on the IRRR. (e.g., a 1dB difference will give a 3dB error).

9. Blocking (desensitisation)

This test is a measure of the ability of the receiver to discriminate between a wanted signal at the receiver frequency and an unwanted signal at any other frequency. It is somewhat similar to the test for adjacent channel rejection, except that the interfering signal is tuned over a frequency range of +/-1MHz to 10MHz) from the wanted channel frequency.

The method of measurement is:

- i) Connect the equipment as shown in Fig.3.15.
 - ii) Signal generator A should be tuned to the receiver channel frequency and modulated with 30% AM, or an FM deviation of 60% of the rated system deviation, by a 1kHz modulation tone. This should then be set for a SINAD level of 12dB.
 - iii) Signal generator B should be unmodulated and set to an RF level of between 80 and 90dB above the level of generator A.
 - iv) Vary the frequency of generator B over the ranges +/- (1MHz to 10MHz) from the frequency of generator A.
 - v) When a response is found (shown by a significant change in the SINAD ratio) vary the level of generator B until a reduction to 6dB SINAD is obtained at the AF output.
 - vi) The output level of generator B is the block level of the receiver for the frequency concerned.
 - viii) The blocking level for any frequency between the specified ranges, should not be less than -17dBm, except frequencies at which spurious responses are found.
 - viii) Plot the results.
- Spurious response at frequencies which are sub-multiples of the receiver input frequency are ignored, as these are normally caused by signal generator harmonics; responses at frequencies between the adjacent channel frequencies should be excluded also.
- Generally the two most important spurious signals that the receiver will respond to are the image frequency and the intermediate frequency.
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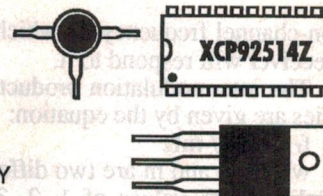
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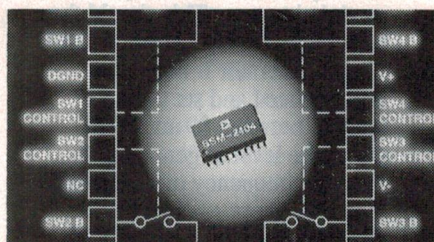


'Clickless' audio switching

Analog Devices' low cost SSM-2404 quad audio switch packs four SPST bilateral switches in a single 20-pin plastic or SOIC package. Because its performance characteristics are far superior to those of common CMOS switches or relays, the SSM-2404 is ideal for low cost per switch alternatives for audio signal routing applications. The SSM-2404's maximum 45 ohm (28 ohm typical) ON resistance is at least four times less than that of conventional CMOS switches used for audio.

Total harmonic distortion (THD) from 2V rms, 1kHz signals under a 10k load is just 0.0065%. OFF isolation and crosstalk under identical conditions is a low -100dB and -94dB, respectively. Wideband noise density over the full audio bandwidth is 0.6uV peak-to-peak.

The SSM-2404 is adaptable for use in all types of professional, consumer and automotive audio equipment. With the addition of only one logic inverter, the SSM-2404 can be connected as a DPDT switch that routes stereo signals to or from two sources or destinations. Guaranteed break-before-make switch-



ing ensures that all four switches open before any one switch reaches the ON state — critical in mixing consoles and other multichannel applications.

Operations from either a single +12 to +24V or dual +/-5.5 to +/-12V power supplies permits its use in low power, battery operated automotive, and multimedia audio gear. Conventional TTL logic levels allow remote, computer or microprocessor control of the SSM-2404's operation, and optional current-mode switching extends its signal-handling range. With 35pC of charge injection, click free audio switching is possible.

For further information circle 271 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Small outline FIFO chips

The industry's first series of high-performance clocked FIFO's in Shrink Small Outline Packages (SSOP), that meets critical speed requirements and accomplish a smoother integration process than the '720X FIFO standard, is now available from Texas Instruments.

The 56-pin SSOP-packaged FIFO's are well suited for high performance equipment and system applications such as engineering workstations, supercomputers, multi-processor systems, high performance graphics, imaging and vision systems, DSP-to-host processor interface, data acquisition, Local Area Network (LAN)/Wide Area Network (WAN) interface, Synchronous Optical Network (SONET)-based transmission systems and digital cellular base stations.

At 18 bits, the TI clocked FIFO's are twice the width of conventional 8-bit and nine-bit FIFO's. The SN74ACT7813 is organised as 64 words deep x 18-bits wide; the SY74ACT7805 is organised as 512 words deep x 18-bits wide. Each device in the series conforms to the same



pinout and AC/DC electrical specifications to simplify future upgrades, eliminating costly layout and foot print changes.

The devices are offered in speed sorts of up to 67MHz. Access times are as low as 12ns maximum when driving a 50pF load and switching all outputs simultaneously. When driving a 30pF load, access times are reduced to 8.5ns, typically.

For further information circle 272 on the reader service coupon or contact Advanced Component Distributors, Unit 2, 17-19 Melrich Road, Bayswater 3153

High power 900MHz transistors

Motorola has introduced a very high power, single package lineup of linear transistors for use from 800 to 960MHz. The three discrete device lineup consists of the MRF899 output part, the MRF897 30W driver and the MRF896 3W pre-driver, aimed at delivering 150W for use in linear base situations handling pulse code modulated signals in digital cellular communications.

The MRF899 transistor delivers 150W of output power at 9dB typical gain, and 26V supply, and is housed in a common emitter, push-pull package configuration. The MRF896 and MRF897 are 3W and 30W linear transistors with high gain (12dB typical) and are designed for 24V operation.

Features of the linear transistor lineup also include good linearity and outstanding reliability from silicon nitride passivation, gold top metal and emitter ballasting.

For further information circle 276 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantima 3152; phone (03) 887 0711.

Car phone receiver chip

Siemens offers a set of universal GSM chips for car telephones, including the PMB 2400 receiver chip which converts the incoming RF signal to IF for further processing down to baseband level. This chip will be used in the first generation of portable GSM terminals.

The PMB 2400 receiver chip employs the heterodyne principle. A downconverter translates the receive signal (D network, 900MHz band) to an intermediate-frequency (IF) signal in the range 45 to 90MHz. The signal is then fed via a channel selector to an adjustable IF amplifier and a limiting amplifier.

The latter supplies a voltage as a function of the signal strength, with a dynamic range of 50 to 60dB. This can be used as a control voltage as well as an indication of signal strength. The gain controlled amplifier (regulation range 70dB, max. gain 75dB) maintains the IF signal at constant level ahead of the baseband demodulator. The gain is set by the voltage applied to the chip control input.

The IF signal then undergoes baseband

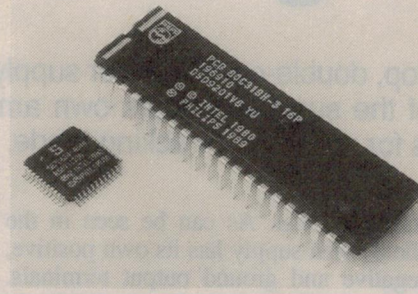
Quad flat pack microcontrollers

Philips' 80C51 microcontrollers in 40-pin DIL are now available in the industry standard QFP44 (Quad Flat Pack) package. Measuring only 12mm square, QFP44s give users an 80% reduction in board area over the 40-pin DIL package, and a 50% reduction over the equivalent PLCC package.

OTP (One Time Programmable) derivatives are also available in QFP44. OTP is ideal for prototypes and production runs where it offers faster time to market and increased flexibility between ROM code changes. Programming OTP QFP44 is supported with the LCP40-QFP44 adaptor which allows a QFP

device to be programmed in the 40-pin socket of the LCPX5X40 or compatible programmer.

For further information circle 274 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4455.



conversion in a quadrature demodulator into its I and Q components. Apart from the I and Q signal outputs, the receive chip employs only balanced circuitry and differential signals.

This, combined with separate ground and supply voltage connections for the stages preceding and following the IF filter, ensures excellent decoupling even at the high frequencies, and hence a high degree of stability for the entire receiver circuit. In terms of noise matching it is possible to achieve a low single sideband noise level of about 10dB and a high intercept point.

Overall, the single-chip design for signal reception means fewer filters and saves space on the circuit board. On changeover from the active to the standby state, the chip's current drain falls from about 27mA (at 4.5 to 5.5V) to just a few microamps. The chip is supplied in an SMD package.

For further details circle 273 on the reader service coupon or contact Siemens Electronics Components, 544

Church Street, Richmond 3121; phone (03) 420 7345.

Sub-miniature voltage reference

Ideal for space critical applications, the National Semi LM431 voltage reference is available in the sub-miniature (3 x 1.3mm) SOT-23 surface mount package.

The LM4431's advanced design eliminates the need for an external stabilising capacitor, while ensuring stability with any capacitive load.

The LM4431 uses fuse and zener-zap reverse breakdown voltage trim during wafer sort to ensure that the parts have an accuracy of better than $\pm 2.0\%$ at 25°C .

Bandgap reference temperature drift curvature correction and low dynamic impedance ensure stable reverse breakdown voltage accuracy over a wide range of operating temperatures and currents.

Key specifications are output voltage tolerance (25°C), $\pm 2.0\%$ (max); low output noise (10-100Hz), 35uV RMS (typ); wide operating current range,

100uA to 15mA; commercial temperature range, $0^\circ\text{--}70^\circ\text{C}$ with a low temperature coefficient of 30ppm/ $^\circ\text{C}$, typ.

Applications are portable, battery powered equipment, data acquisition systems, instrumentation, process control, energy management, product testing, automotive and power supplies.

For further information circle 278 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766.

5GHz SMD active mixer

Hewlett-Packard has introduced a version of one of its widely used silicon monolithic double-balanced active mixers in a low cost, industry-standard SO-8 surface mount package.

The IAM-82008 covers the frequency ranges used for global positioning system (GPS) receivers, microwave distribution systems, unlicensed spread spectrum communications in the 900MHz and 2.4GHz bands, and fibre optic communications systems as well as cellular and cordless telephones. This active mixer offers conversion gain to 5GHz and IF to 2GHz, which makes it a cost effective way to provide downconversion, upconversion, frequency multiplication, transition detection or phase detection in commercial applications.

The IAM series of monolithic mixers offers the equivalent of double-balanced mixer, IF amplifier and LO buffer in a single package. It requires only external blocking capacitors for operation and offers +8dBm IF output power capability, up to 15dB conversion gain and operation with an LO signal of only 0dBm.

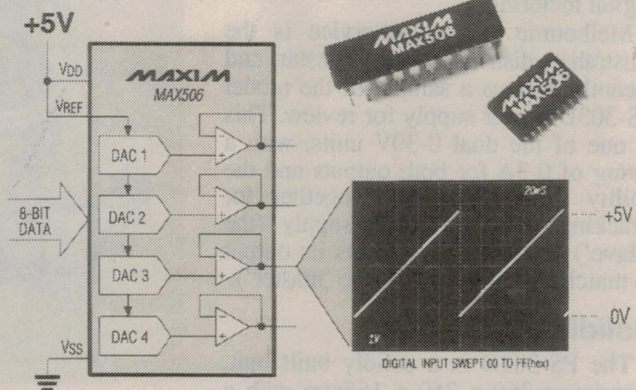
For further information circle 279 on the reader service coupon or contact VSI Promark Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 4655.

Rail-to-rail quad 5V DAC

The new Maxim MAX505/MAX506 quad DAC's operate from +5 or $\pm 5\text{V}$, and provide full rail-to-rail output swing for trimming offsets, setting thresholds, and attenuating analog signals to any voltage within the supplies. Rail-to-rail output swing allows full use of the power-supply range, unlike other DACs that restrict useful power-supply range.

The MAX505/506 combine four 8-bit DACs and four op-amps on a single chip, saving board space and eliminating the need for trim pots. Total unadjusted error (TUE) is 1LSB max over temperature and the 500kHz reference input bandwidth is ideal for multiplying applications. The MAX505 contains double-buffered logic inputs to allow simultaneous updating of all outputs, and has four independent reference inputs for full flexibility. The MAX506 has a single reference input shared by all four DACs.

Applications include minimum component count analog systems, digital offset/gain adjustment, arbitrary function generators, industrial process control and automatic test equipment.



For further information circle 275 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

Power Supply Feature:

Dual tracking 30V/3A supply

The Lodestar PS-303D is a bench top, double-output power supply, in which the voltage outputs can be connected for tracking. Each of the supplies has its own ammeter and voltmeter, and also is equipped with independent controls for use in non-tracking mode.

Taiwan based manufacturer Lodestar Electronics has been making economically priced test and measuring instruments for some years now. These are marketed around the world under their own brandname, and others as well. Rumour has it that they may also produce some of the products for other makers of similar equipment, based in Japan and elsewhere.

The instruments concerned range from small signal tracers and SWR meters through capacitance meters and AC millivoltmeters, to signal and function generators, TV pattern generators, frequency counters, oscilloscopes and distortion, wow and flutter meters. All of the instruments tend to be solidly made, but designed to represent 'good value for money' rather than pushing the frontiers of measurement technology.

A less well known part of the Lodestar range is a family of regulated variable benchtop power supplies, for the workshop and lab. The range includes some nine models, covering from a compact 0-12V/12-24V single 3A supply, with a single switched meter, to a heavy duty 0-16V/10A single output/single meter supply and four different dual 0-30V supplies, with ratings of either 3A or 5A and either analog or digital metering.

Melbourne firm MacService is the Australian distributor for Lodestar, and recently sent us a sample of the model PS-303D power supply for review. This is one of the dual 0-30V units, with a rating of 0-3A for both outputs and the ability to connect them together for 'tracking' — where one supply (the 'slave') automatically adjusts its output to match that of the other (the 'master').

Solidly built

The PS-303D is a solidly built unit, measuring 360 x 260 x 155mm with a case made from steel sheet and aluminium extrusion. The layout of the control panel, with its various control knobs and output sockets, is both tidy

and functional. As can be seen in the photo, each supply has its own positive, negative and ground output terminals. Each 0-30V DC output is continuously variable, with its own coarse and fine controls. Each supply also has continuous current limiting from 0-3A, with automatic limiting above 3A.

The load regulation is quoted at $\pm(0.25\%+3\text{mV})$ and the line regulation at $\pm(0.025\%+2\text{mV})$, with ripple and noise (to 10kHz) less than 5mV peak-to-peak, (0.5mV_{RMS}). The output impedance of the unit is stated as less than 0.2 ohm, typical.

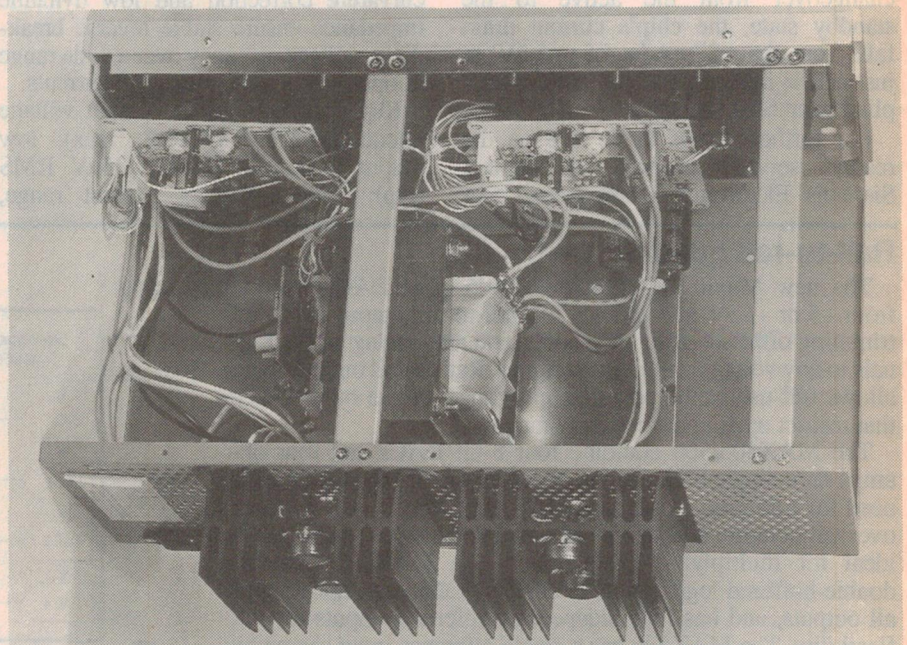
The meter ranges are described as: voltage, 0-30V; and current, 0-600mA, 0-3A — all with an accuracy of 2.5% of full scale. However, you will search in vain for a switch to use the dual current range, even though the meters are calibrated for both scales, and the switch

is even shown on the schematic diagram given in the manual!

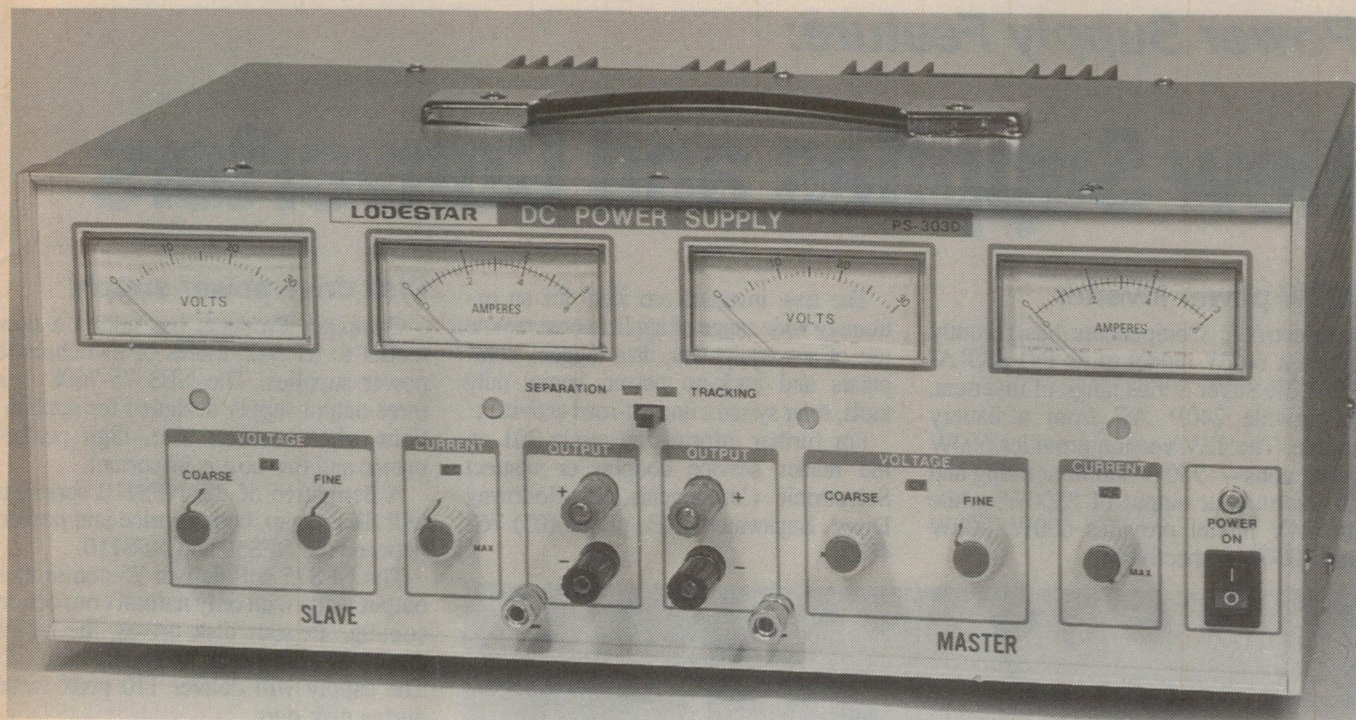
The supplies are protected against short circuit, and should a short occur, there is a double indication that this has happened. First of all, a lamp above the current limiting knob will light when a short or overload occurs, and secondly, another lamp above the voltage control knobs (which glows for normal operation) will extinguish. A slider switch (in the centre of the panel) controls the choice of 'separation' or 'tracking'.

When set to separation, each supply functions completely independently; but when set to tracking, the slave output will automatically have the same voltage as the master supply. However, the maximum current can still be set individually for each channel, even in tracking mode.

In tracking mode, the positive output



Inside the case, most of the circuitry is mounted on two small PC boards positioned vertically behind the front panel. The power transformer placed in the centre, with the series-pass power transistors on heatsinks attached to the back panel. The rear panel and the cover are both provided with ventilation holes.



The PS-303D provides two 0-30V supplies, each capable of delivering up to 3A, which can be coupled for tracking.

of the 'slave' supply must be linked to the negative output of the 'master'. This allows them to be used for either dual-polarity outputs with respect to a common link, or in-series to produce a 0-60V/3A supply.

Test results

The line regulation was tested with 240V line voltage, and the unit delivering 1A into a load, at an output voltage measuring 17.990V. When the 240V was altered $\pm 10\%$, the output voltage increased only 1mV for 264V (+0.006%), but decreased 15mV for 216V (-0.08%). This latter result is well outside the quoted figure ($\pm 0.025\% + 2\text{mV}$) — though this could well be due to a badly made internal adjustment on the sample unit tested.

The load regulation was checked for both master and slave by comparing voltages for unloaded outputs with that for full load. All results were well within stated accuracies. Both supplies gave their best results near the high voltage mark, and only a slight decrease in accuracy occurred after passing the transformer tap switching point. (The supply automatically senses the output voltage, and uses a relay to switch between 34V and 18V transformer taps for higher and lower voltages.) In fact, the worst case result gave the highest DC source impedance as only 7.5 milliohms.

When ripple and noise measurements were made, both the master and

slave, at both the high and low voltage taps, gave results which were all around the 5mV peak-to-peak (quoted accuracy is $< 5\text{mV}$). With a load drawing slightly over 4A, when current limiting was switched on, the ripple on the master supply rose to 260mV (for 3A) and 90mV (for 1A). The corresponding results for the slave supply were slightly higher.

These increased ripple figures were not exactly unexpected, as most power supply designs sacrifice the ripple rejection when it is necessary to control a current overload.

Values for meter accuracy varied from a very low 0.06% (slave voltmeter) to a very high 9% (main ammeter)! Again, adjustment of the internal preset pot would probably return this high figure to within the stated 2.5% accuracy.

With the two supplies connected in tracking mode, there was a small tracking error which increased towards the top end to a high of just over 1.5%. This error is probably quite acceptable, though again it should be able to be reduced with its internal trimpot. In general, there seemed to be no significant deterioration of the slave regulation when it was used in the tracking mode.

Finally, with the two supplies connected in series to double the output voltage, the regulation was 0.14% for a 3A current delivered at around 59V — again well within stated accuracy.

Evaluation

Overall, the Lodestar PS-303D is quite a good supply, but the quality control seems to be a bit lax in terms of calibration and adjustment (see earlier comments). And the manual is far from marvelous!

For example, consider these instructions: "Note that the two inside connectors (one + and the other -) should be connected together when the supply is used in tracking mode". This is supposed to mean that you connect the negative of the *master* to the positive of the *slave* — connecting the other two terminals causes a short! (This same connection needs to be made when using the two supplies in series, though no mention at all is made of this in the instructions.)

The manual is also, unfortunately, typical of many that we see these days — with its misprints, vague instructions, and poor English (the "supply will find wide application.. with the advanced *hobbiest*"). However, its lack of clear instructions for using the tracking mode could prove to be far from a laughing matter. Despite this, if the user doesn't mind a bit of setup and calibration, this unit would be quite good value for money.

The price of the Lodestar PS-303D is \$495. It is available from MacService, 23 Fulton Street, Oakleigh South 3167; phone (03) 562 9500. (P.M. & J.R.) ♦

Power Supply Feature:

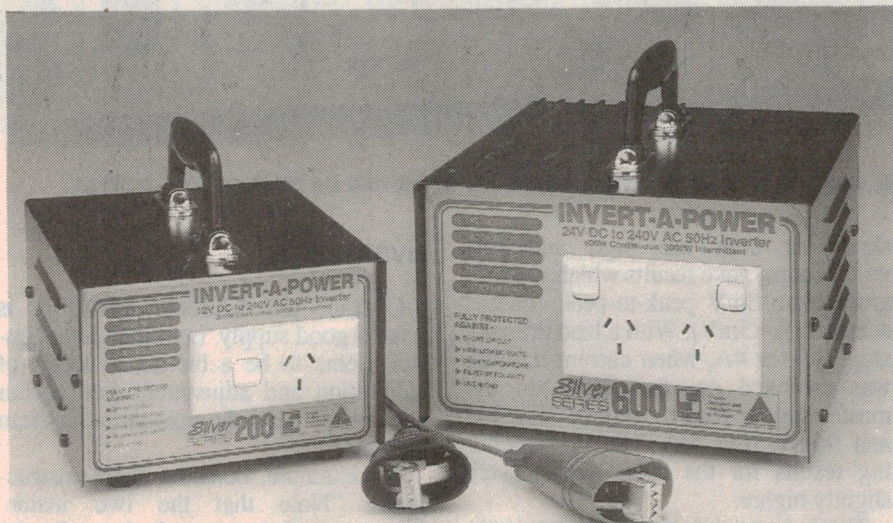
New Supplies and Converters

600W power inverter

Selectronic Components has recently added a 600W model to its INVERT-A-POWER Silver Series range of inverters, to provide 240V AC from a battery source. The 12V version provides 600W continuous — 750W half hour rating and an intermittent output of 2300W; while the 24V model provides 600W, 900W and 3000W respectively.

The new inverters are ideal for an extremely wide range of applications: remote use of test equipment, data loggers, computers and back-up power, heavy duty tools, solar systems and off-road activities.

For further information circle 201 on the reader service coupon or contact Selectronic Components, 25 Holloway Drive, Bayswater 3153; phone (03) 762 4822.



Programmable 10A power supply

The new TSX35-10P programmable power supply, designed and manufactured by Thurlby-Thandar, has just been released. This is a 35V, 10A model incorporating both GPIB and addressable RS232 (ARC) interfaces as standard.

The ARC system allows up to 32 instruments to be 'daisy chained' together, and to be individually addressed and controlled using a single RS232 port on a computer. Bus controlled functions include set voltage, set current, set OVP, set output On/OFF, read voltage and read current.

The heart of the instrument is a regulator design which combines switch mode pre-regulation with linear post-regulation. The pre-regulator uses specially developed techniques to dramatically reduce the capacitance between input and output, eliminating the high levels of common-mode noise normally associated with switch-mode sup-

plies. The linear post-regulator combines with very low levels of output noise with excellent load regulation and transient response.

Voltage and current levels may be entered directly from the keypad on the front panel, to a resolution of 10mV or 10mA. Alternatively, a rotary control can be used to set voltage or current, simulating a conventional analog control. Voltages and currents may be stepped up and

Disk drive power supply

Computer Products has added a new model to its NFS series of switchmode power supplies. The NFS 75-7608 is a three output supply designed for applications where smaller size, high performance and low cost is important.

A derivative of the NFS110 series, it will fill the gap, both in price and power, between the NFS50 and NFS110.

The NFS75 will deliver 75 continuous output watts with only natural convection cooling. To start disk drives, the +12V output will deliver an unusually high 6A. The supply will deliver 110 peak watts during disk start.

Universal input allows the supply to operate from any line voltage throughout the world without manually setting a switch or jumper position.

The NFS 75-7608 is approved by UL, CSA and VDE, and its built-in line filter reduces conducted noise below the FCC limit B and VDE limit A.

Like other NFS products, the unit will maintain regulation down to zero output load. It offers short circuit protection with auto-restart, in a compact 170 x 100 x 40mm package, and can be used in many types of small digital systems, such



down by a fixed increment set from the keyboard.

The output is fully protected and software for operating the TSX35-10P under GPIB or ARC control is available, including a Labwindows driver and ARC-TALK software for a PC.

For further information circle 202 on the reader service coupon or contact Nilssen Instruments, 200 Berkeley Street, Carlton 3053; phone (03) 347 9166.

as data acquisition systems, signal analysers, test and analytical equipment.

For further information circle 205 on the reader service coupon or contact Amtex Electronics, 13 Avon Road, North Ryde 2113; phone (02) 805 0844.

High performance 10W DC/DC converters

The Datel XWR (Wide Range Input) series of high efficiency, 10W DC-to-DC converters are constructed on ceramic, using ultra-low profile surface mount components, and the latest in thick film hybrid circuit techniques.

High frequency, current mode design allows up to 10W of fully regulated, very low ripple (25mV, min) power, with operating efficiencies to 84%.

Wide input voltage ranges (2:1,4:1) and pin-to-pin compatibility with most other major manufacturers make these converters ideal as drop-in replacements or for new designs.

Input voltage ranges of 4.7-7.0V DC, 9-18V DC, and 18-72V DC are available in both unipolar (UWR) and bipolar (BWR) output configurations (3.3V, 5V, 12V, 15V, +/-5V, +/-12V, and +/-15V DC. Their efficient use of space allows power densities to 12 watts per cubic inch (max) in an ultra-low profile 2" x 1" x 0.38" package. Operating temperature is -25°C to +105°C (ambient).

Outputs are non-latching and current limiting with reverse polarity current

protection rated at 6A (max). Thermal protection is provided by auto shutdown at 115°C (case temperature).

Overvoltage clamping, continuous auto-recovery short-circuit protection, 100us transient response time (50% load step), and automatic overvoltage shutdown further protect the power converter and other delicate circuitry from extreme conditions.

For further information circle 208 on the reader service coupon or contact Quiptek Australia, PO Box 129, Moorabbin 3189; phone (03) 532 1328.

Switching regulators

Worldwide in mobile applications, higher supply voltages are becoming more and more common. Battery voltages from 80V to 120V are no longer exceptional. Also galvanic isolation to the electronic systems is not always required.

Therefore Melcher offers a new range of switching regulators from 20 to 576 watts, for input voltages up to 144V DC (120V +20%). To comply with the German railway norm LES-DB for nominal voltages up to 110V, the input circuit is dimensioned to allow surges up to 156V DC for two seconds.

High efficiencies up to 95%, excellent regulation characteristics, continuous no-load and short-circuit-proof, programmable output voltage and a maximum ambient temperature range of -40°C to +71°C without derating are

built-in microprocessor to set voltage, current limit, range, OVP, displays and over-current protection.

Remote control is achieved via an RS-232C connection. Separate large character LED displays are provided for both voltage and current.

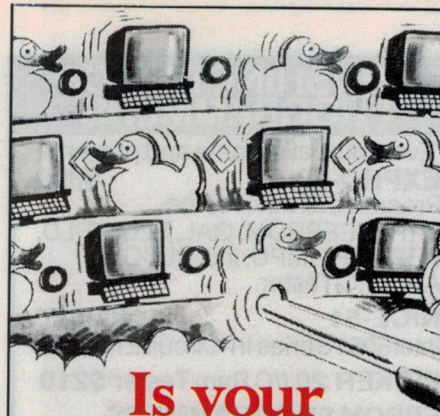
Four types of protection are provided: over voltage, over current, constant current, and short circuit.

For further information circle 206 on the reader service coupon or contact Amalgen Industries, 43 Anderson Road, Mortdale 2223; phone (02) 570 2855.

Programmable bench top supply

Amalgen Industries has released a new range of DC power supplies. Designated the NIKO Programmable Power Supply Series, they are designed to meet most bench top applications in laboratories, testing, servicing, R&D and education environments.

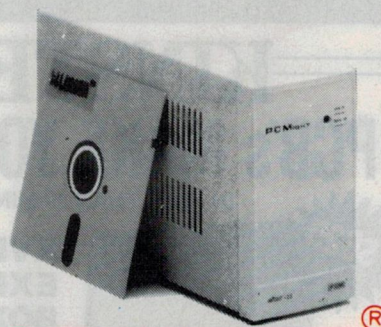
Providing 75 watts of DC power in four models from 0-12.5V to 0-125V, the NIKO PPS is controlled by a convenient front panel keypad that commands a



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other major features of these switching regulators.

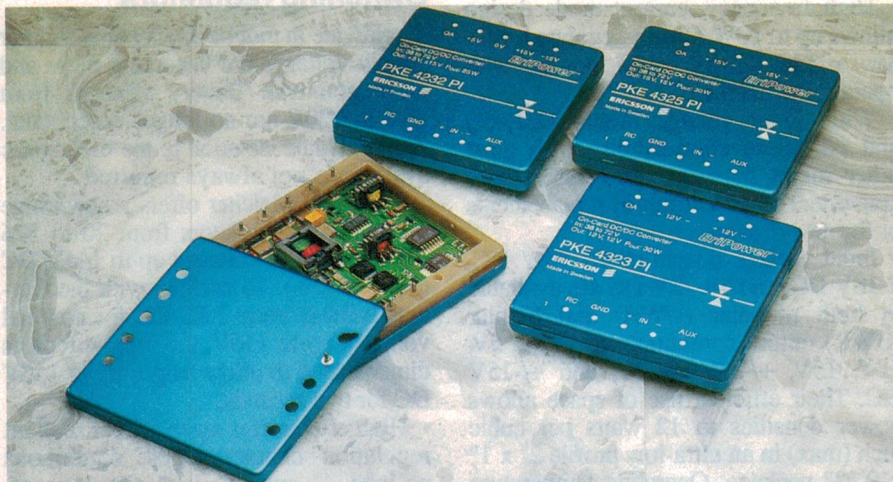
For further information circle 204 on the reader service coupon or contact Jeseq, Unit 1, Sibthorpe Street, Braeside 3195; phone (03) 587 4044.

Low profile DC/DC converters

Ericsson Components has released three new models in a new series of reliable, low profile DC/DC converters, intended to be used as onboard distributed power supplies in natural convection-cooled decentralised power systems, e.g., in tele and data communications. Designated the PKE series and designed for

48 and 60V battery systems, the series consists of five different models of single, dual and triple output voltage versions in a low profile (10.7mm/0.42") standard 3x3" footprint package.

The low profile allows as low as 0.7" board spacing. The PKE introduces 1500V DC input to output isolation, an upcoming need for many future telecommunication applications. The isolation is in accordance with the recent established EN41003 and UL1459 standards. Input voltage range is 38 to 72V DC, in order to accommodate 48 and 60V battery system requirements. The min. input voltage is set to 38V DC, and



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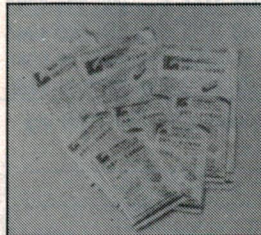
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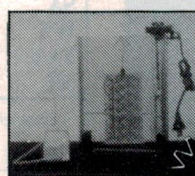
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an adjustable low voltage shutdown facility turns off the converter to protect the batteries against excessive and harmful discharge.

No extra heatsinking arrangements or output power derating is needed up to +85°C ambient temperature. The PKE series is designed in thickfilm hybrid technology and uses proprietary inhouse designed and manufactured drive and control chips. Switching frequency is 300kHz, resulting in a ripple frequency of 600kHz and a power density of up to 8.0watt per cu.in.

For further information circle 210 on the reader service coupon or contact EC Capacitors, 59 Radford Road, Reservoir 3073; phone (03) 462 2855.

300W power supplies

Priority Electronics has released the UN1300 series of single-rail DC output-switching power supplies. They have selectable 90-130/180-264V, 47-440Hz AC input, and are fully compliant with FCC and VDE standards.

They also have AUSTEL Certified Component Listing, over-temperature protection, overload protection, over voltage protection, and remote sense — inhibit control. There are five models to choose from for DC output requirements, 5V at 60A, 12V at 25A, 15V at 20A, 24V at 13A and 48V at 6.5A. All models are also offered as quad 300W supplies (50/60Hz AC input) - the UN4300 series.

All have a common 5V DC adjustable output at 40A, with the remaining three auxiliary rails providing 12V-15V-24V and 5V DC in isolated combinations to provide the quad output 300W power supplies.

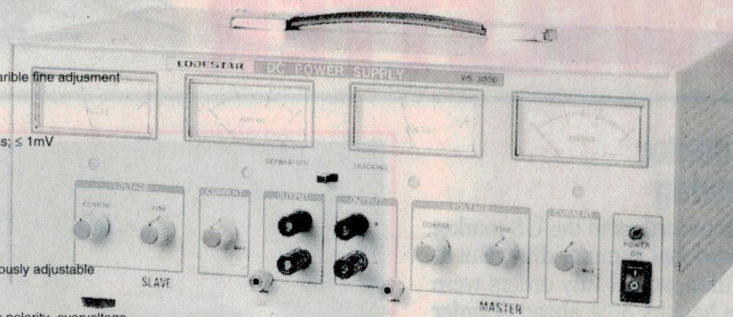
For further information circle 207 on the reader service coupon or contact Priority Electronics, 1/23 Melrose Street, Sandringham 3191; phone (03) 521 0266.

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MODEL PS-303D
CONSTANT VOLTAGE (CV) $\pm 0-30\text{VDC}$
CONSTANT CURRENT (CC) 0-3A

Specification

- A) Constant Output Voltage Range (CV):
Load Regulation: $\leq 0.01\% + 3\text{mV}$
Line Regulation: $\leq 0.01\% + 3\text{mV}$
Recovery Time: 100nS Typical
Ripple Voltage: Peak to Peak $\leq 0.2\% \text{ Vrms}$; $\leq 1\text{mV}$
Temp. Coefficient: $5\text{mV}/^\circ\text{C}$ Typical
- B) Constant Current Range: 3A
Adjustable Line Limit: 5% to 10%, 0.1A to 3A
Current Line Regulation: $\leq 0.2\% + 3\text{mA}$
Load Regulation: $\leq 0.2\% + 3\text{mA}$
Ripple Current: $\leq 3\text{mA}_{\text{RMS}}$
Output Range: 0 to Rating Current continuously adjustable
- C) Protection: CC/CV indicating Lamp.
Protection against reverse polarity, overvoltage short circuit, overload protection fully adjustable, current limiting and fuse primary protection.
- D) Meter: Built-in type, Analog indicator, voltmeter x 2 pcs and Ammeter x 2 pcs, $\pm 2.5\%$ of Full Scale.
- E) Operations Mode: This unit can be operated either as two entirely independent single power supplies, two separate DC voltage, or combined in tracking mode to produce equal dual (+) and (-) power supplies.
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Silicon Valley NEWSLETTER



Semiconductor sales growing

Semiconductor orders in the US market took their traditional summer dive. But at US\$1537 million, actual July orders were still running a healthy 30% ahead of order levels a year ago.

The Semiconductor Industry Association released its latest chip business figures showing a continuing booming US market, with a book-to-bill ratio of 1.09, down from 1.14 in June — which set industry records for both bookings and shipments.

Three month average orders (US\$1599 million) were down 5% while actual orders declined 11% from June to July. Actual shipments, which were pushed to a record US\$1628 million in June, declined 16.5% to US\$1365 million.

Industry analysts said the declines in orders and shipments were to be expected this time of year. Independent analysis, however, shows that orders have outnumbered shipments for each of the past seven months, leaving the industry with an order surplus of nearly US\$1 billion — an unprecedented level in chip industry history.

The surplus should allow the industry to do well during August and September, even if new orders were to plunge, and even provide a strong foundation for the fall — when orders are expected to return to pre-summer levels.

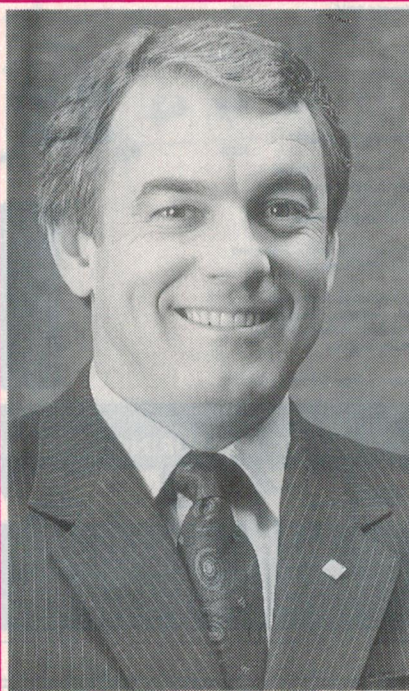
If the US market stays on the current course, growth this year could well exceed even the recently released 15 - 17% forecasts from Dataquest and In-Stat.

C&T drops its 486 program

Already under severe financial duress, Chips & Technologies has bowed to pressure from Intel and halted development of a 486-based microprocessor.

Instead, Chips said it would focus its product strategy on high volume controllers, and inexpensive single-chip computers aimed at handheld computer markets.

To date, during four years of research, Chips has spent some US\$60 million on developing a replica of the 486. As part of that program, the company was able to develop and launch a replica of the 386.



The rather confident gentleman pictured is James C. Morgan, chairman and CEO of San Jose chip production equipment maker Applied Materials, Inc. Currently, his firm is fighting a court case with former employees who claim they were forced to attend religious seminars run by the Church of Scientology.

Chips officials said their decision to abandon the 486 program was based on mounting frustration with the legal obstacles put up by Intel.

In addition, according to market analysts, Chips was probably unable to further sustain the heavy R&D and legal costs involved in bringing a 486 chip to market. And with 386 and 486 prices falling rapidly, the return of the investment may have become too small to justify continuing on a risky course.

One analyst said there may have been other reasons for C&T to pull out of the 486 effort. "Some insurmountable problem must have raised its ugly head to make them back away. It is not like Gordon Campbell (C&T chairman) to walk away from a challenge" said chip industry analyst Erik Jansen.

IBM PC spin off rumours louder

Reports that IBM plans to spin off its personal computer division continue to gain momentum. An announcement of the formation of what would be the world's largest personal computer company could come very soon, as IBM is scheduled to announce a series of major new PC products.

The latest report comes from industry executive sources. IBM has refused to comment on the report, other than to say that the company's PC group 'will continue to evolve'.

An independent IBM PC unit would be a formidable competitor. With 11,000 workers and sales of US\$8.5 billion, the group would be able to react swiftly to the typical rapid changes in the PC market. In the past, IBM has been slow to take advantage of new markets such as portable and laptop computers.

According to the report, IBM would begin the spin-off process by reporting the PC group's financial results separately from its other operations. After three years, IBM would be allowed to sell stock in the subsidiary to the public.

The new unit would include most of IBM's desktop computer operations, except for the RS/6000 line of workstations. And it would also exclude the OS/2 operating system, which IBM would continue to develop and market in support of the PC group.

IBM's interest in ridding itself of the PC operation may be based on the lacklustre performance of the group, which has been a drag on IBM's earnings results.

Judge ends Apple-Microsoft case

Federal Judge Vaughn Walker put an end to a four year legal battle between Apple Computer on the one hand and Microsoft and Hewlett-Packard on the other, by re-affirming his April ruling that cleared Microsoft of virtually all charges filed by Apple in a landmark 'look-and-feel' copyright infringement lawsuit.

After his initial stunning ruling from the bench, Walker issued a 75 page

detailed report which cleared Microsoft and H-P on the basis of two key principles. First, Walker said, Apple had given Microsoft a broad licence to copy the look and feel of the Macintosh graphics user interface. And secondly, many of Apple's claims of copyright infringement were based on issues such as overlapping windows, which cannot be protected by copyright in the first place.

The ruling puts an almost certain end to the battle in which Apple was seeking a whopping US\$5.5 billion in damages from Microsoft, an amount Apple said represented the amount of money Apple has lost in hardware and software sales as a result of the popularity of the Macintosh-like Windows operating system and GUI.

Walker issued the second ruling after Apple Computer had asked the judge to reconsider his earlier ruling.

Officials of Apple said the company was 'very disappointed' in the ruling. But one spokeswoman added that it will not affect Apple's plans. "We never based our business plan on a victory in this case, and we will continue to move ahead."

Still, the Apple case leaves a number of major issues to be resolved by other courts, if not the US Congress. For one, it remains uncertain whether companies can claim copyrights of certain critical 'look-and-feel' features, even though those features are not part of the computer code itself.

Consortium to develop optical PCBs

Four of the largest US high-tech companies have formed the Optoelectronic Technology Consortium, in an effort to develop fibre optic based circuit board technology that would dramatically increase the speed of data moving between chips and peripheral devices inside a computer.

The OTC was formed by IBM, AT&T, General Electric and Honeywell and is sponsored in part by the Defense Advanced Research Projects Agency (DARPA), which has contributed the first US\$8 million in R&D funds.

Currently, metal-wire-based circuit boards can transfer data at up to 20 million bits per second. With microprocessors quickly moving to the 50 - 100MIPS levels, a major bottleneck is developing in computers' ability to transfer data as quickly as the CPU can process it.

DARPA and the OTC members believe a fibre optics solution is the most logical way to achieve a dramatic improvement in data transfer capability. The current record for optical data transmission stands

at about 100 million bits per second over a lone foot length. The OTC has as its goal to improve this record to 500 million bps over a 33-foot long cable.

The OTC will conduct the research over the next 30 months at the laboratories of all four members. Fibre optics have considerable advantages over metal-based wiring.

Besides the higher throughput speed, fibre optics does not produce an electromagnetic field which can interfere with data in other wires nearby.

Firm accused of 'enforcing religion'

A trial is about to get underway against chip equipment maker Applied Materials, in which three former employees of the San Jose firm claim they were forced to take part in religion oriented seminars and when they refused, were harassed to the point where they had to resign.

Silicon Valley firms frequently send workers to a variety of self improvement seminars, many of them held on site. But in this case, the workers claimed that the firm their former employer hired was actually a recruitment arm of the Church of Scientology, a 'New Age' church which has often been accused of financial exploitation of its members.

Applied Materials has denied it knew the company, Applied Scholastics, had close ties to the church. Applied also says it terminated its contract with the Fremont firm after employees complained about the religious aspects of the seminar, which were supposed to help workers communicate more effectively with each other. But the former workers claim they were harassed by other Applied workers and managers after they refused to take further part in the seminars.

Among the charges in the suit, the workers claim Applied violated their constitutional rights by forcing them to be exposed to the recruitment tactics of the Church of Scientology.

"These people were forcibly exposed to the Church's courses by Applied Materials, and when they complained about it, they got harassed, criticised and threatened until conditions became so intolerable they were forced to resign," said Steven Hunziker, an attorney representing one of the three workers.

H-P board passes data at 266Mbps

A revolutionary circuit board from Hewlett-Packard will allow PC's, workstations, mainframes and supercomputers to transmit data to each other at the rate of 266 megabits per second, about 25

times the speed limit in networks such as Ethernet.

H-P developed the US\$495 HQLC-0266 board in co-operation with IBM. The board translates digital data into light impulses which are sent over optical fibre cables to other computers along a network. Signals can be sent to computers up to two kilometres away.

H-P said the boards will be geared to large network users in corporate and university environments, where computers are spread out over several buildings. The high speed will allow networks to vastly improve capabilities for quickly transmitting complex graphics images between computers. That will make the H-P board particularly attractive to such places as hospitals, H-P said, where the boards will allow doctors to quickly transmit X-ray or magnetic resonance images to different locations in the hospitals.

Among the first users of the H-P board is Lawrence Livermore Laboratory, which is building a prototype computer network using the boards to transmit data between supercomputers and workstations.

H-P will market the device directly to system manufacturers, who can incorporate the circuitry into their motherboards or add facilities that will allow the board to be plugged into the machine. The first machines built around the optical communications board could be on the market by early next spring.

AMD and Du Pont to make Flash cards

Advanced Micro Devices has teamed up with Du Pont Connector Systems to develop and manufacture Flash based memory cards for portable computers.

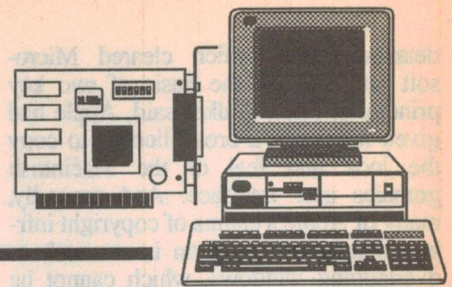
Under the terms of the agreement, AMD and Du Pont will form a joint venture that will make memory cards using AMD made Flash memory chips. AMD will then sell the cards worldwide to computer makers.

The deal came less than a week after AMD announced it would split the cost of building a US\$700 million Flash chip plant with Japan's Toshiba.

The AMD move also signals a trend in which chip makers want to compete in both the open Flash chip market, as well as the memory card business. Already Intel has become the leader in the memory card market.

Memory cards are expected to become the data storage medium of choice in the portable computer markets, often competing head-on with sub-3" hard disk drives. ♦

Computer News and New Products



CD recorder runs at double speed

Philips Components division has launched in Australia an optical disc recorder that can make one-off copies of discs under all the CD formats — CD-ROM (XA), photo CD, CD-I and audio CD — all from the user's desktop.

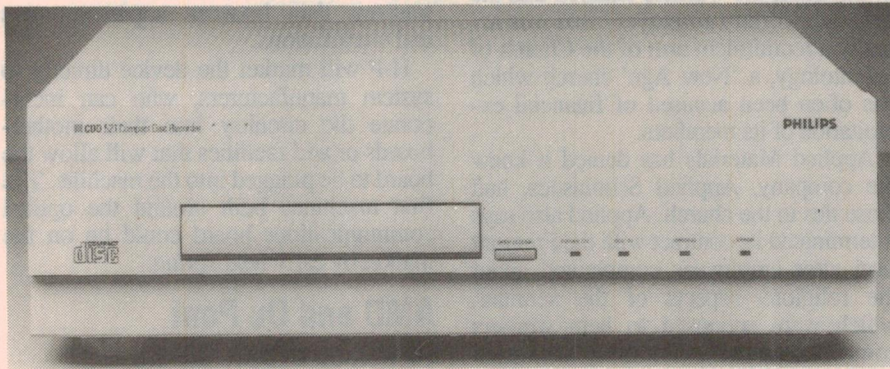
The unit is the first CD Recordable Double Speed drive on the market, allowing recording speeds of 20MB/minute and double speed playback, as well as multi volume recording and interfacing for the most popular computer systems.

The unit has received endorsement

from numerous computer companies promising support and software development—including Meridian Data, Digital, Young Minds and Optical Media International. Platforms supported include MS-DOS, Unix, Apple and Novell networks.

With a list price of \$9750, Philips CDD521 CD recorder is ideal for many applications such as inhouse corporate publishing, software distribution in CD format, master discs for CD authoring studios, and low quantity distribution (on demand) of reference databases.

For further information circle 161 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4455.



PC-based electronic servicing

Australian manufacturer of automatic testing equipment for the electronic sector, Binary Engineering, has released a new line of testers for the electronic service sector. Known as the TESTBENCH 3000, the testers are assembled into a related suite of three PC-based instrument modules, designed to help the service engineer in his day-to-day repair problems of poorly documented printed circuit boards. The TESTBENCH 3000 provides

a microprocessor-based emulation module (PC9000) for testing the kernel of all eight and 16-bit microprocessors, including bus, ROM, RAM and I/O, using simple high level commands.

A second module, known as the TM3000 Dynamic Troubleshooter, is a cliptester for digital ICs, and uses the dynamic reference comparison (DRC) technique for quickly testing most devices at full operational speed. Device types that may be tested include PALs, PLDs, RAMs, 4000, 7400 and 7500 series logic and most microprocessor

support ICs, up to a maximum speed of 20MHz.

The third and final module in the TESTBENCH suite is a 48-channel logic analyser (LA4800), capable of operation up to 200MHz and extendable up to 156 channels.

The multiway trigger incorporated in this instrument makes it very flexible. Disassemblers to suit most microprocessors are also available.

For further information circle 163 on the reader service coupon or contact Binary Engineering, PO Box 995, Brookvale 2100; phone (02) 938 5344.

Re-writable optical drive

Pinnacle Micro Systems has introduced the PMO-650, a rewriteable optical drive of 650MB capacity, with performance claimed to rival that of many hard disk drives.

The performance comes from an advanced split-optic design developed by Pinnacle, which results in an ultra lightweight optic head. Coupled with a rotation speed of 3600rpm — more than 50% faster than other optical drives — and direct seek technology, an effective access time of 19ms is achieved. Sustained asynchronous data rates are in excess of 1MB/sec.

The Pinnacle PMO-650 can replace existing hard drives for general data storage or can be used for vertical applications such as digital audio, digital video or multimedia. The unit is a plug-and-play optical drive that is recognised by UNIX operating systems as a standard removable hard drive. Unix commands such as mount, unmount and format can be used to access the drive.

For further information circle 164 on the reader service coupon or contact Elmeasco, PO Box 30, Concord 2137; phone (02) 736 2888.

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Intelligent LEDs

Low Cost Intelligent Displays (LCIDs), the 'intelligent' LED displays from Siemens, permit a reduction in costs and power drain in comparison with previous commercially available displays.

The individual dots in the new displays — the 8-character SCD 558X and the 10-character SCD 5510X — can be programmed by a conventional micro-processor or controller via a serial input.

Various means have been used to reduce the power drain of the new displays. The dot matrix has been changed from 5 x 7 to 5 x 5 dots, resulting in a corresponding 30% reduction, while the integrated CMOS controller can also be switched to the power-down mode, when its power draw falls from an initial 5mW to less than 250uW.

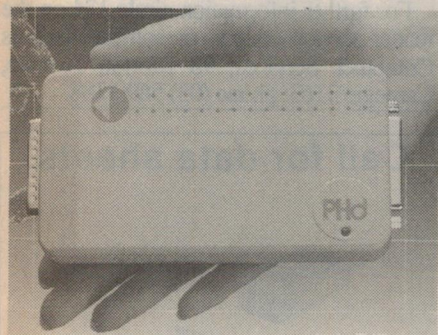
For further information circle 162 on the reader service coupon or contact Siemens Electronic Components Department, 544 Church Street, Richmond 3121; phone (03) 420 7345.

Pocket hard disk

KT Technology has released the Pocket Hard Disk (PHd) which enables users to carry their office computing environment wherever they travel, in the most convenient form yet offered.

Small enough to sit in a shirt pocket or handbag, the PHd offers from 40 to 120MB of storage, requiring only two short cables to be plugged into a host anywhere in the world. The PHd enables the user to carry both files and their familiar software with them, and use it without disturbing a host system's configurations.

The unit can be connected to any paral-



lel port on the host, and a piggy-back plug is fitted into the keyboard socket. The accompanying boot disk automatically finds the port and adds a command line to recognise the PHd as the next logical drive. If the chosen port happens to be a printer port already in use, this does not affect the system, as the printer can be connected to the other side of the PHd

and continue to be used from any part of the system or network, transparently.

The PHd is designed to be used globally and is independent of external mains power voltages. It can be used on any modern DOS system without the need to alter the host's configuration or settings. It has a range of four storage capacities from 40 to 120MB, with retail prices from \$549.

For further information circle 166 on the reader service coupon or contact KT Technology, Central Boulevard, Portside Business Park, Port Melbourne 3207; phone (03) 626 5755.

Improved digital still camera



Dycam has announced the release worldwide of its new Model 3 camera. At 496 x 365 pixels, it has 60% more resolution than the Model 1, as well as four times the Model 1's dynamic range. This makes it suitable for professional users involved in desktop publishing, design, database and training applications.

Incorporating a new CCD sensor and auto flash, the Model 3 overcomes the white 'burnout' common with its predecessor. Image storage has been increased from 24 to 100 hours, making it ideal for field use. It can now be directly connected to any modem for image transfer at any baud rate, as well as directly connected to a computer serial port for direct image downloading. Versions are available for Macintosh and DOS/Windows users. The Model 3 comes with image editing software for DOS/Windows and Macintosh platforms.

The Model 3 has a list price of \$1895, plus tax. For further information circle 167 on the reader information coupon or contact Sprinter Products, PO Box 259, Manly 2095; phone (02) 977 8155.

Passive backplane PC chassis

The IPC-610 is a PC/XT and PC/AT compatible computer chassis, designed for a board variety of applications. The rugged, all steel chassis meets the EIA RS-310C 19" rack mounting standard.

The unit includes a 12-slot PC-bus compatible passive backplane, and a high efficiency switching power supply in a dual-fan cooled chassis.

The 12-slot passive backplane of the IPC-610 minimises downtime and simplifies troubleshooting, makes upgrading easier and system packaging more efficient. All electronics are modular in design and can be easily serviced. The add-on cards include CPU, video, disk control and I/O interface. They can be installed and replaced from the top of the unit.

A wide variety of CPU cards are available for the IPC-610 including 80286, 80386 and 80486 based models. An all-in-one CPU card like the PCA-6146 contains 33MHz 80486 CPU, up to 16M RAM, two RS-232, one parallel, IDE & FDD control, 'watch dog' timer and an onboard ROM disk facility — all in one single, plug-in card. The industrial BIOS permits boot-up without keyboard or video adaptor. A revised version, the IPC-610B, has been designed to adapt the popular and low cost 'Baby AT' motherboard, should this control option be desired.

For further information circle 168 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Special Protel offer

The two most popular CAD products ever released by Australian firm Protel Technology — Autotrax and Schematic — are now combined and offered for a low \$495. The copy-protection lock has also been eliminated from Autotrax.

The package gives a complete design system with over 3000 schematic library components, PCB footprint library, full auto-placement and auto-routing, with Gerber file and N/C drill file generation, and SMD design support. Other features include user definable tracks, pads, vias, fills, along with global and macro editing.

Files generated with Protel for DOS will be fully convertible to the new Windows-based Protel packages, Advanced PCB and Advanced Schematic, if you decide to upgrade in the future.

For further information circle 169 on the reader service coupon or contact Protel Technology, GPO Box 204, Hobart 7001; phone (002) 73 0100.

COMPUTER PRODUCTS

Laser printer has inbuilt sharer

Siemens has launched a shared interface version of Mannesmann Tally's heavy workload, high performance laser printer, the MT911. The printer allows four users to be connected simultaneously, resulting in higher throughput for lower costs.

The MT911SI sharer has four built-in serial interfaces, with 256K of buffer space on each port. The machine automatically switches data to the active interface thus enabling each system to be freed quickly. If the printer is busy, jobs are automatically placed in a queue.

For further information circle 180 on the reader service coupon or contact Siemens Advanced Information Products, 544 Church Street, Richmond 3121; phone 008 032 954.

Universal programmers

Sunshine Electronics has added a second model to its line of PC-based universal programmers and testers. The EXPRO-80 is an enhancement of the EXPRO-60.

The hardware features of the EXPRO-60 include a 40-pin test socket, with 40 sets of software controlled circuits, programmable TTL I/O, three groups of programmable D/A voltage sources and two groups of programmable OSC output sources.

The devices that can be programmed are EPROMs to 1Mb; EEPROMs; bipolar PROMs; Intel 8748-8752; APL, EPLD, GAL, PAL; and Motorola and Signetic CPUs.

The enhanced EXPRO-80 has a 42-pin design, and allows a greater variety of ICs and higher memory capacities to be programmed. Other additional features are the availability of a negative power

Card prevents data loss

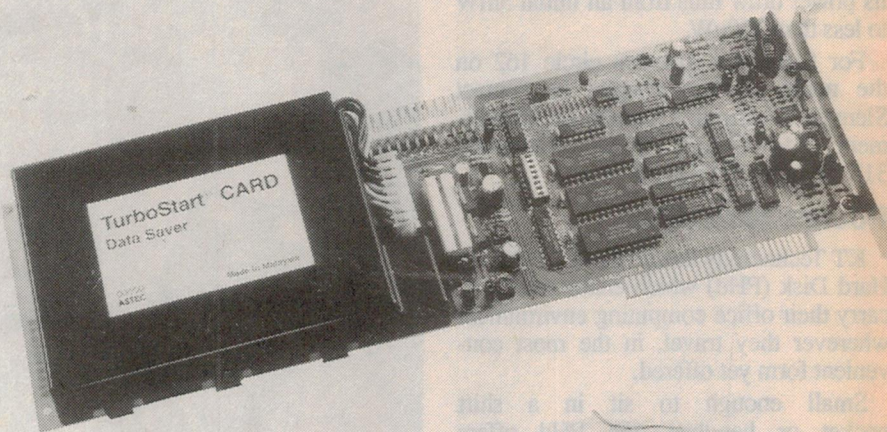
Astec's newly released Turbostart card is an internal full length card and software which gives the PC user full protection from loss of data due to breaks in mains power and brown outs. The card uses just one slot of an IBM or compatible computer when mounted adjacent to a half length card.

When total mains power is lost or fluctuations occur, the card saves all memory to the system's hard disk, orderly parks the hard drive and then shuts down the computer. When power is restored, the automatic resumption feature will restore the system permitting the session to be continued from

precisely the same point at which the power loss occurred.

The card is also a software productivity tool, featuring memory system imaging (MSI), with save and restore capabilities. This feature allows the user to 'swap' between two MSI images instantly, thus bypassing the usual lengthy start up and shut down, opening and closing procedures. For example, you can swap between a Windows 3.1 application and a CAD program at the press of a user programmable 'hot key'.

For further information circle 170 on the reader service coupon or contact Eltec Australia, Level 7, 91 Phillip Street, Parramatta 2150; phone (02) 893 1800.



source, and a self-detection circuit to protect ICs from damage by inadvertent operation.

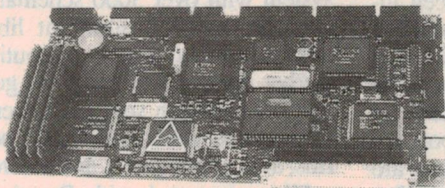
The functions of the two universal programmers can be further extended with 68 adaptors and 17 PLCC converters. These cover five groups: PROM/MPU, PLD, gang socket, PLCC converters and a special group (e.g., testing SIMM RAM).

Another handy tester is the Sunshine

Picker 20, whose functions include IC type and number selection, function test and unknown IC number searching. It will test digital ICs and DRAMs in the TTL 74 series, CMOS 40 and 45 series, and DRAM 4164, 41256, 411000 and 4-bit versions.

For further information circle 174 on the reader service coupon or contact Nucleus Computer Services, 98 Morton Avenue, Carnegie 3163; phone (03) 569 1388. ♦

Australian Computers & Peripherals from JED... Call for data sheets.



The JED 386SX embeddable single board computer can run with IDE and floppy disks, or from on-board RAM and PROM disk. It has Over 80 I/O lines for control tasks as well as standard PC I/O. Drawing only 4 watts, it runs off batteries and hides in sealed boxes in dusty or hot sites.

It is priced at \$999 (25 off) which includes 2 Mbytes of RAM.

JED Microprocessors Pty. Ltd.

Office 7, 5/7 Chandler Rd., Boronia, Vic. 3155. Phone: (03) 762 3588 Fax: (03) 762 5499



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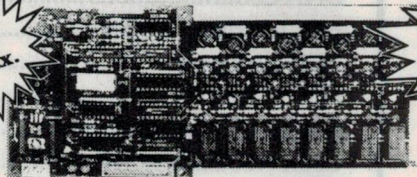
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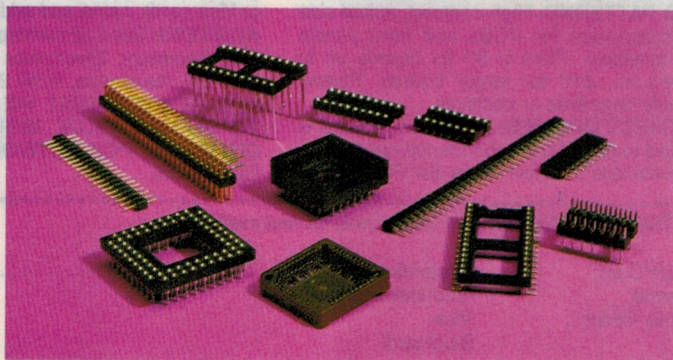
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A Kits and modules

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C PC boards and supplies

D Components

E IC chips and semiconductors

F Test and measuring instruments

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Brand new 6 volt 1 watt amorphous solar panels, 150mm x 150mm, will deliver one watt whilst charging 6-8V batteries. Two of these in series make a great 12V battery maintainer/charger. Have weather protection, and terminating clips are provided. Incredible pricing:

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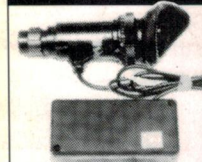
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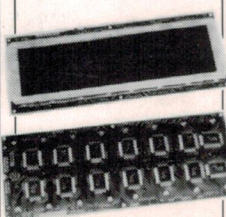
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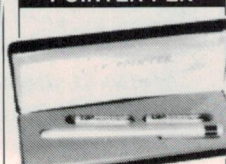
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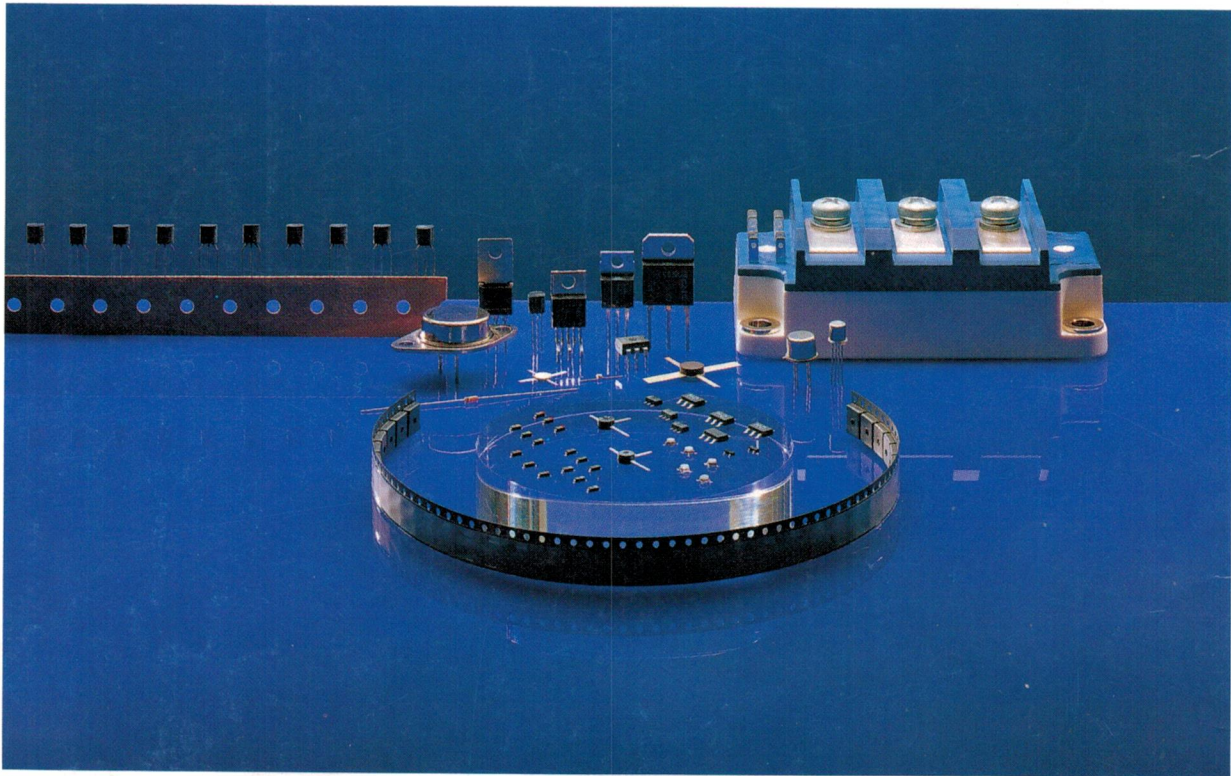
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